009930

Y/TS-633

#94

Y-12

OAK RIDGE Y-12 PLANT

MARTIN MARIETTA

OAK RIDGE Y-12 PLANT GROUNDWATER PROTECTION PROGRAM MANAGEMENT PLAN

Helen L. King
C. Stephen Haase

May 1990

Prepared by the
Environmental Management Department
Health, Safety, Environment, and Accountability Division
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84-OR21400

#94

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Y/TS-633

OAK RIDGE Y-12 PLANT GROUNDWATER PROTECTION PROGRAM MANAGEMENT PLAN

Helen L. King[1]
C. Stephen Haase[2]

Issue Date: May 9, 1990

1 Health, Safety, Environment, and Accountability Division, Oak Ridge Y-12 Plant
2 Environmental Sciences Division, Oak Ridge National Laboratory

Prepared by the
Environmental Management Department
Health, Safety, Environment, and Accountability Division
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84-OR21400

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACL	Alternate Concentration Limit
BCV	Bear Creek Valley
BCVWDA	Bear Creek Valley Waste Disposal Area
CABF	Cochran's Approximation of the Behrens-Fisher Student T-Test
CERCLA	Comprehensive Environmental Response and Liability Act
CM	Corrective Measures
DOE	Department of Energy
EAP	Environmental Assessment Plan
EAR	Environmental Assessment Report
EMD	Environmental Management Department
ERP	Environmental Restoration Program
ESS	Environmental Surveillance Section
FFA	Federal Facility Agreement
GWPS	Groundwater Protection Standard
GWQAP	Groundwater Quality Assessment Plan
GWQAR	Groundwater Quality Assessment Report
HSEA	Health, Safety, Environment, and Accountability Division
HSWA	Hazardous and Solid Waste Amendments
HWDU	Hazardous Waste Disposal Unit
LLWD	Low-Level Waste Disposal
MCL	Maximum Concentration Limit
MOU	Memorandum of Understanding
NPDES	National Pollutant Discharge Elimination System
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation

ACRONYMS (continued)

PCPA	Post-Closure Permit Application
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAS	Statistical Analysis System
SWDF	Solid Waste Disposal Facility (nonhazardous waste)
SWMU	Solid Waste Management Unit
TDHE	Tennessee Department of Health and Environment
TEGD	Technical Enforcement Guidance Document
TSD	Treatment, Storage, and Disposal (Unit)
TVA	Tennessee Valley Authority
USGS	United States Geological Survey
UEFPC	Upper East Fork Poplar Creek
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank

1. INTRODUCTION

1.1 PURPOSE AND SCOPE OF THE MANAGEMENT PLAN

The purpose of the Y-12 Plant Groundwater Protection Program (GWPP) Management Plan is to formalize and structure the groundwater protection program both for internal consistency and ease of external review. This plan meets the requirements for a Groundwater Protection Management Program and Groundwater Monitoring Plans as described in the U. S. Department of Energy (DOE) Order 5400.1. The contents of the plan have been assembled to reflect the following scope:

1. To define the purpose, policies, and objectives of the Y-12 Plant GWPP.

2. To define the organizational roles and responsibilities of personnel involved in the GWPP.

3. To define the interfaces between the GWPP and other programs.

4. To define the methods, procedures, and schedules to be utilized in meeting the GWPP objectives.

5. To provide effective quality maintenance for the GWPP. (A separate quality assurance [QA] plan meeting NQA-1 requirements will be developed for the program.)

6. To provide the most effective overall management possible for the GWPP.

The Oak Ridge Y-12 Plant GWPP Management Plan is intended to serve as a "living" document which will be routinely updated and reissued. The format has been designed to provide for the updating of individual sections independent of the rest of the document. The plan as a whole will be reviewed annually and will be revised and reissued every three years. Sections which are revised between reissue dates will be numbered and dated.

Where appropriate, this management plan incorporates material by reference. All referenced materials are subject to annual review, revision, and reissue. Materials referenced within this plan are maintained by the GWPP as described in Section 5.11, "Recordkeeping and Reporting".

1.2 PURPOSE, POLICIES, AND OBJECTIVES OF THE Y-12 PLANT GWPP

The purpose of the Oak Ridge Y-12 Plant GWPP is to characterize the hydrogeology and to monitor groundwater quality at the Y-12 Plant and surrounding environs. These tasks are conducted primarily in support of: (1) the Environmental Surveillance Program (ESP), (2) plant operations requiring groundwater monitoring either under RCRA interim status or permits, or under solid waste management regulations, (3) the Environmental Restoration Program (ERP), which includes 3004(u) RCRA Facility investigations (RFIs), and CERCLA Remedial Investigations/Feasibility Studies (RI/FS) (currently incorporated into RFIs), (4) Underground Storage Tank (UST) corrective actions, and (5) permitted solid waste management units. Other programs which are supported on an as needed basis include Facilities Decommissioning and Decontamination (D&D), UST, and Low-Level Waste Disposal (LLWD). Support for the above programs is provided by including

technical advice and assistance, sampling and analysis, data management, data interpretation, report preparation, and regulatory negotiation. Subsequent sections of this plan describe the organizational responsibilities, specific methods, and procedures to be utilized in providing the above support.

The policy of the Y-12 Plant GWPP is dictated by Energy Systems Policy Procedure ESH-14, "Environmental Protection and Waste Management." It is the policy of the GWPP to provide for protection of groundwater resources at the Y-12 Plant consistent with federal, state, and local requirements and in accordance with DOE orders and corporate policy. Section 2 of this management plan describes applicable federal and state regulations and DOE orders pertaining to groundwater programs.

It is the objective of the GWPP to provide support to the listed programs consistent with the stated policy in the most technically sound, cost-effective, and timely manner possible. The GWPP Management Plan is the first step toward meeting this objective.

1.3 HISTORY OF THE Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

The Oak Ridge Y-12 Plant is operated by Martin Marietta Energy Systems, Inc. (Energy Systems) for DOE under contract No. DE-AC05-84OR21400. It is located in Anderson County, Tennessee and is within the corporate limits of the City of Oak Ridge. The plant is separated from the populated area of Oak Ridge by Pine Ridge and is located on the floor of Bear Creek Valley at about 950 ft above sea level. Bear Creek Valley is bounded on the northwest and southeast by parallel ridges that rise about 300 ft above the valley floor. The Oak Ridge Y-12 Plant and its fenced buffer area are about 0.6 mile wide by 3.2 miles long and cover approximately 4,900 acres. The main industrialized section of the plant encompasses approximately 800 acres. The Y-12 Plant is one of three major DOE complexes located on the 37,000-acre Oak Ridge Reservation (ORR) in Anderson and Roane counties.

The Oak Ridge Y-12 Plant was built by the U. S. Army Corps of Engineers in 1943 as part of the Manhattan Project. The original mission of the plant was to separate the fissile isotope of uranium (^{235}U) from natural uranium using the electromagnetic process. Production of ^{235}U by this method was discontinued after World War II in favor of the more economical gaseous diffusion process. Since then, the plant has developed into a sophisticated manufacturing, development, and engineering organization. Current missions of the Oak Ridge Y-12 Plant include: (1) fabrication of nuclear weapons components; (2) support of DOE's nuclear weapons design laboratories; (3) processing of special nuclear materials; (4) support of other DOE installations in Oak Ridge and Paducah, Kentucky; and (5) support to other government agencies. Major Y-12 production responsibilities involve the fabrication of various materials into weapons components, certification of the fabricated components, and production of subassemblies from some of the components. Materials typically used include enriched uranium, depleted uranium and its alloys, lithium hydride and deuteride, aluminum alloys, tungsten-nickel-iron alloy, specialty steels, lead, some precious metals, and refractory metals such as tantalum and niobium.

The Oak Ridge Y-12 Plant GWPP began in 1975 (Pritz, 1983), when periodic sampling of groundwater in 17 preexisting wells was initiated to monitor groundwater quality in and around waste disposal sites at the Bear Creek Burial Grounds. All of the 17 wells initially monitored consisted of steel casing, and very little information was available on well

construction details to facilitate interpretation of groundwater quality data obtained from them. Available construction data on these wells are summarized in King, Schaefer, and Haase (1989). During the period 1978 through 1981, several additional monitoring wells were installed within the Bear Creek Valley waste disposal facilities. Construction details for these wells are summarized in King, Schaefer, and Haase (1989).

From 1981 through 1982, annual, biannual, or quarterly sampling was conducted in 22 monitoring wells located at 3 sites (2 wells at the Chestnut Ridge Sludge Disposal Basin, 4 wells at the S-3 Ponds, and 16 wells at the Bear Creek Valley Burial Grounds) throughout the Y-12 complex (Law Engineering, 1983). Well sampling procedures and analytical parameters for groundwater samples collected during this period are described by Law Engineering (1983) and available data on well construction are summarized in King, Schaefer, and Haase (1989). Additionally, during 1983, Law Engineering conducted hydrogeological investigations at four sites (the Chestnut Ridge Sediment Disposal Basin, the S-3 Ponds, the Oil Landfarm, and the Bear Creek Valley Burial Grounds). A report containing results of groundwater sampling, pumping tests, geological investigations, and recommendations for future studies and groundwater monitoring activities was issued in late 1983 (Law Engineering, 1983).

In response to the Memorandum of Understanding signed by the DOE, the United States Environmental Protection Agency (USEPA), and the Tennessee Department of Health and Environment (TDHE) on May 26, 1983, a master monitoring plan for groundwaters and surface waters at the Y-12 plant was developed and implemented (Pritz 1983). The monitoring plan identified a network of 29 wells that were located within and surrounding six waste disposal areas (Central Sanitary Landfill II; S-3 Ponds; Bear Creek Burial Grounds, including the Central Sanitary Landfill I and the Oil Landfarm; Chestnut Ridge Sediment Disposal Basin, Chestnut Ridge Security Pits, and the United Nuclear Disposal Site). The monitoring well network included the 22 wells that had been installed and sampled throughout the period 1981 through 1982. Only 2 of the 29 wells in the network were among the original 17 steel-cased wells that had been monitored since 1975. The remaining 27 wells in the network were drilled with an air rotary rig using an 8-in-diameter roller cone bit. The monitoring wells were constructed with 6-in diameter polyvinyl chloride (PVC) schedule 40 or 80 casing. Many of the wells have randomly cut slots in the casing or holes drilled in the casing instead of manufactured well screens. In general, each well was drilled through the unsaturated zone and extends partially into weathered bedrock, with well depths ranging from 18.5 to 181 ft. Typically, 10 to 22 ft of slotted PVC casing were placed in the borehole. The remainder of the casing is solid, and contains glued joints. The annular space is packed with sand or gravel adjacent to the slotted casing, and the remainder of the annular space was packed with bentonite and grout seal. Initial wells of this series were reported not to be gravel or sand packed (Pritz, 1983). Analytical parameters and sampling frequencies varied from site to site, depending in part on the quantities and types of wastes disposed of at the various sites. Details of these parameters and sampling procedures are summarized in Pritz (1983).

On March 19, 1983, DOE released a report, prepared in 1977, that contained preliminary information on mercury losses and unaccounted-for mercury at the Oak Ridge Y-12 Plant. As part of a subsequent investigation to evaluate the extent of mercury contamination in soils and groundwater within the Y-12 Plant complex, a 43-well groundwater monitoring network was installed in 1983 (Rothschild et al., 1984). The monitoring wells were installed at 24 locations within a 6000- by 2000-ft area within the main industrialized portion of the Y-12 complex. At most of the locations, 2- or 3-well piezometer clusters were installed. Typically, in a three-well piezometer cluster, one well was completed at shallow depths (10 to 25 ft) in soil and unconsolidated material above bedrock, a second well was completed at intermediate depths (20 to 40 ft) in weathered bedrock, and a third

well was completed in unweathered bedrock at depths between 70 and 80 ft. Wells were drilled by auger and air rotary rigs and were completed with 5-ft-long, 4-in-diameter, spiral wound stainless steel well screens. Casing above the well screens was 4-in-diameter, schedule 40 PVC pipe with bell couplings in place of glued joints. Additional construction and hydrogeological details for these wells are summarized in Rothschild et al. (1984) and King, Schaefer, and Haase (1989). Analytical results from soil samples obtained during well construction and from groundwater samples obtained from the wells are presented in Rothschild et al. (1984), which also contains a discussion of hydraulic properties of subsurface intervals obtained from slug tests performed in some of the monitoring wells.

During the period 1983 through 1984, intensive hydrogeological investigations were begun at three waste disposal areas, Bear Creek Burial Grounds, Oil Landfarm, and the S-3 Ponds, in Bear Creek Valley. The objective of these investigations was to obtain hydrogeological data necessary to support the development and implementation of remedial actions at the sites (Geraghty and Miller, 1985a). Hydrogeological investigations were initiated by Bechtel National, Inc. and were continued by Geraghty and Miller, Inc. At the direction of Bechtel National, two phases of monitoring well installation were completed in late 1983 and early 1984 (Bechtel, 1984a,b,c,d). A third phase of monitoring well installation was completed in late 1984 under the direction of Geraghty and Miller (Bechtel, 1985; Geraghty and Miller, 1985b,c). During the three phases of monitoring well installation, 99 wells were installed as follows: 59 additional groundwater monitoring wells were installed in the Bear Creek Burial Grounds, 29 additional monitoring wells were installed at the Oil Landfarm, and 11 additional monitoring wells were installed at the S-3 Ponds. The additional wells installed during this period are constructed from either 2- or 4-in-diameter stainless steel casing and typically have either 5- or 10-ft-long, spiral-wound stainless steel well screens. The additional wells were installed using either auger or air rotary drill rigs. Wells were installed to monitor both the unconsolidated zone, with zones typically ranging from 20 to 25 ft,and the upper bedrock zone, with depths ranging from 20 to 80 ft. Several wells were also installed to monitor groundwater in bedrock intervals to depths of 219 ft. Construction details and hydrogeologic information on the 99 wells are summarized by Geraghty and Miller (1985a) and King, Schaefer, and Haase (1989).

During 1985, Geraghty and Miller, Inc. directed a fourth phase of monitoring well installation at the Bear Creek Burial Grounds, the Oil Landfarm, Central Sanitary Landfill I, and the S-3 Ponds (Geraghty and Miller, 1986). This phase of drilling was designed in large part to investigate the deeper portions of the groundwater flow system at the three waste disposal sites. Sixteen wells were installed in phase IV, with ten of the wells monitoring depths between 40 and 285 ft and six of the wells monitoring depths between 460 and 600 ft. Typically, the wells were installed adjacent to other wells so as to form piezometer clusters. All of the wells were constructed with open hole completions with the open hole interval ranging from 10 to 50 ft in length. Construction data and hydrogeological information for the wells are summarized in Geraghty and Miller (1986). Preliminary results from groundwater sampling and well recovery behavior are summarized in Geraghty and Miller (1987a).

To fulfill groundwater monitoring requirements for RCRA interim status at several treatment, storage, or disposal facilities and to conduct initial hydrogeological characterization at several non-RCRA sites, 55 monitoring wells were installed at eight localities throughout the Y-12 Plant in 1985 (Haase et al., 1987a). RCRA Interim status sites investigated were Chestnut Ridge Security Pits (five wells in addition to one existing well), New Hope Pond (11 wells), Chestnut Ridge Sediment Disposal Basin (six wells in addition to two existing wells), and Kerr Hollow Quarry (seven wells). Additional 500-ft-deep core holes were drilled for site characterization purposes at Kerr Hollow Quarry and the Chestnut Ridge Sediment Disposal Basin. Other sites investigated include: Beta-4

Security Pits (six wells), Ravine Disposal Site (5 wells), Rogers Quarry (seven wells), United Nuclear Site (three wells in addition to two existing wells), and several nonwaste disposal sites investigated in cooperation with the United States Geological Survey. Depths of wells installed ranged from 10 to 441 ft. The wells monitored groundwater in the unconsolidated, weathered bedrock, and unweathered bedrock zones. One or more three-well piezometer clusters were installed at each of the waste-disposal sites investigated. Wells were installed using auger or air rotary drilling rigs. Wells were completed using either spiral wound stainless steel well screens or open hole completions. Monitored intervals typically were 5 or 10 ft long, although in some instances they were as great as 50 ft. Information on site investigation planning, well placement, and site hydrogeology are contained in Haase et al. (1987a). Well construction details are summarized in Haase et al. (1987a) and King, Schaefer, and Haase (1989). Weekly water level measurement and quarterly groundwater sampling were initiated. Preliminary discussion of hydrogeologic information and groundwater quality data are presented in Haase et al. (1987b,c).

Detection monitoring of groundwater required by RCRA interim status was initiated at New Hope Pond, Chestnut Ridge Security Pits, Chestnut Ridge Sediment Disposal Basin, and Kerr Hollow Quarry in January 1986. In December 1986, Groundwater Quality Assessment Plans (GWQAPs) for three RCRA interim status sites, the S-3 Ponds Waste Management Area, the Oil Landfarm Waste Management Area, and the Bear Creek Burial Grounds Waste Management Area were put in place (Geraghty and Miller, 1987b,c,d). Since implementation of the GWQAPs for these sites, annual Groundwater Quality Assessment Reports (GWQARs) have been issued (Geraghty and Miller, 1987e,f,g; 1988a,b,c; 1989a,b,c). Detection monitoring of the East Chestnut Ridge Waste Pile was initiated in September 1987. In January 1988, GWQAPs for two additional RCRA interim status sites, New Hope Pond, and the Chestnut Ridge Security Pits, were implemented (Geraghty and Miller, 1987h, 1988d). Results for the first year of assessment monitoring at these sites are presented in Geraghty and Miller (1989d,e). Additional monitoring wells at the five sites currently in assessment monitoring (as of January 1990) were installed within the period 1986 through 1988 following recommendations contained in the annual GWQARs for the sites. A total of 59 monitoring wells and 1 exploratory core hole (6 wells at New Hope Pond, 6 wells and 1 core hole at the Chestnut Ridge Security Pits, 2 wells at the Chestnut Ridge Sediment Disposal Basin, 14 wells at the S-3 Ponds, and 31 wells at the Bear Creek Burial Grounds) were installed between 1986 and 1988. The new monitoring wells ranged in depth from 15 to 321 ft and monitored the unconsolidated, weathered bedrock, and unweathered bedrock zones. A summary of site hydrogeological data relevant to the siting of those wells is contained in King, Haase, and LaRue (1989). A summary of construction details for these wells is contained in Geraghty and Miller (1987i, 1989f), EDGe Group (1989a), and King, Schaefer, and Haase (1989).

In addition to groundwater monitoring and characterization activities at the eight sites that have interim status under RCRA, groundwater monitoring has been initiated at some of the 46 solid waste management units (SWMUs) that have been identified for RCRA Facility Investigations under the 3004(u) paragraph of the Hazardous and Solid Waste Amendments to RCRA. Groundwater monitoring at many of these sites was initiated throughout 1986 to 1987. Throughout this period 101 groundwater monitoring wells were installed at 13 SWMUs. Monitoring wells ranged in depth from 8 to 400 ft in order to investigate the unconsolidated, weathered bedrock, and unweathered bedrock zones. Summaries of site hydrogeological information and monitor well placement strategies are presented in King, Haase, and LaRue (1989). Construction details of the monitoring wells are presented in Geraghty and Miller (1987i, 1989f), EDGe Group (1989a), and are summarized in King, Schaefer, and Haase (1989).

During the period 1950 through 1989, numerous other drilling and well installation activities were conducted at the Oak Ridge Y-12 Plant. While many of these projects were completed for engineering and construction site investigations, several of them were for projects that were either directly related to the Y-12 GWPP, or were in support of the GWPP. The United States Geological Survey (USGS) installed groundwater investigation wells at several locations throughout Bear Creek Valley prior to 1975 (construction details of these wells are summarized in King, Schaefer, and Haase (1989)). A second phase of groundwater investigation well installation was completed by the USGS in 1986 (King, Schaefer, and Haase, 1989). The Office of Waste Isolation installed approximately 15 wells in Bear Creek Valley during the period 1976 to 1977 (King, Schaefer, and Haase, 1989). The purpose of these wells was to investigate hydrogeologic conditions related to waste disposal within the valley. During 1985, 10 core holes were installed at four locations in the vicinity of the Oak Ridge Y-12 Plant to characterize subsurface geological and hydrological conditions to depths of 1200 ft below ground surface (King and Haase, 1987 and 1989). During 1987 to 1989 intensive hydrogeological characterization, which included installation of groundwater investigation wells, was conducted at a site approximately three miles west of the Bear Creek Burial Grounds Waste Management Unit (Lee and Ketelle, 1989).

The original comprehensive surface water and groundwater monitoring plan for the Y-12 Plant (Pritz, 1983) was quickly rendered obsolete by the rapid expansion of both the surface water and groundwater programs and requirements since 1984. In 1989 an updated and expanded comprehensive surface water and groundwater monitoring was prepared by Geraghty and Miller (1990).This document provides a comprehensive summary of the regulatory status of over 100 RCRA and CERCLA hazardous waste sites and unregulated nonhazardous waste sites at the Y-12 complex. Additionally, it reviews and summarizes hydrogeological conditions at the plant and surrounding areas. Based on this summary, the plan presents a strategy for groundwater monitoring at the Y-12 complex that is based on the groundwater flow characteristics of the three hydrologic regimes that underlie portions of the facility. The plan is currently in draft form and is undergoing final revision prior to implementation in 1990.

As of January 1990, groundwater monitoring is being conducted at 22 localities throughout the Y-12 complex (Martin Marietta Energy Systems, Inc. 1990). Among the sites, 199 wells are monitored on a quarterly basis and 19 wells are monitored on a biannual basis. Groundwater quality parameters monitored in each of the wells are summarized in Martin Marietta Energy Systems, Inc. (1990). Specific details about the current groundwater monitoring well network and program are contained in the comprehensive surface water and groundwater monitoring plan (Geraghty and Miller, 1990).

2. APPLICABLE REGULATIONS, REQUIREMENTS, AND GUIDANCE

A myriad of state and federal regulations and DOE orders establish the minimum standards and requirements governing all monitoring activities at the Y-12 Plant. The following sections describe the applicable state and federal regulations, DOE orders and guidance documents pertaining to the GWPP at the Y-12 Plant and surrounding environs.

2.1 STATE AND FEDERAL REGULATIONS

Both federal and state regulations are applicable to groundwater monitoring at the Y-12 Plant. Federal groundwater regulations generally are promulgated and enforced by the USEPA. The Y-12 Plant lies within USEPA Region IV, which encompasses the southeastern U. S. The USEPA regional headquarters is located in Atlanta, Georgia.

State groundwater regulations are promulgated and enforced by the TDHE headquartered in Nashville. A TDHE field office for East Tennessee is located in Knoxville, but most Y-12 Plant groundwater interaction with TDHE involves the DOE permitting unit located in Nashville.

Below are federal and state regulations governing groundwater monitoring at the Y-12 Plant and a brief discussion of their applicability.

40 CFR 264, Subpart F - "Releases From Solid Waste Management Units (SWMU)" (264.90 - 264.101), and

TN Rule 1200-1-11-.06(6)(a) - (1), "Releases From SWMUs"

Specifies groundwater monitoring requirements applicable to regulated (permitted) hazardous waste TSD facilities, including detection, compliance, and corrective action programs. Also requires corrective actions for groundwater contamination at nonregulated solid waste management units (SWMUs) which fall under the RFI program, although it does not specify monitoring requirements for these sites.

40 CFR 265, Subpart F - "Groundwater Monitoring" (265.90 - 265.94) TN Rule 1200-1-11-.05(6)(a) - (e), Groundwater Monitoring

Specifies groundwater monitoring requirements applicable to interim status facilities, including detection and assessment programs.

40 CFR 270, Subpart B - "Permit Application" (270.10 - 270.21) TN Rule 1200-1-11-.07(4) - (5), "Contents of Parts A and B"

Specifies groundwater information required in permit applications.

40 CFR 270, Subpart C - "Permit Conditions" (270.31) TN Rule 1200-1-11-.07(8)(a)10, "Monitoring and Records"

TN Rule 1200-1-7-.04(7), "Groundwater Protection/Monitoring Standards for Solid Waste Processing and Disposal Facilities"

Specifies recordkeeping and reporting requirements for groundwater monitoring data collected under permit.

40 CFR 280, "Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks", Subparts D, E, F, and G (280.40 - 280.74)

TN Rule 1200-1-15-.06, "Release Response and Corrective Action for UST systems Containing Petroleum Hydrocarbons" (effective April 15, 1990)

Allows groundwater monitoring for release detection. Requires soil and groundwater contamination to be investigated and corrective actions taken whenever a leak is detected. Requires assessment of soil and groundwater contamination prior to tank closure.

40 CFR 300, Subpart F - "Hazardous Substance Response" (300.61 - 300.71) (No equivalent state regulation)

Requires evaluation of groundwater contamination and hydrogeological conditions when considering remedial alternatives for CERCLA sites.

2.2 DOE ORDERS

The DOE orders prescribe the manner in which the department operations are to be conducted. A number of DOE orders make reference to groundwater protection or monitoring. Below is a list of those orders and a summary of the requirements which pertain to the GWPP.

Order 5400.1, "General Environmental Protection Program," 11-9-88

States DOE policy to conduct operations "in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards." Establishes requirements and guidance for radiological effluent monitoring and environmental surveillance conducted in support of DOE operations and activities. Directs that environmental surveillance programs be conducted to (1) determine whether the public and the environment are adequately protected during DOE operations and whether operations are in compliance with DOE and other applicable Federal, State, and local radiation standards and requirements, and (2) be capable of detecting and quantifying unplanned releases, and (3) that they meet the high standards of quality and creditability. Requires establishment of a groundwater protection management program. Requires groundwater monitoring to determine and document the effects of DOE operations on groundwater quality and quantity. Requires development of specific groundwater monitoring plans. Requires an annual site environmental monitoring report which includes a groundwater protection section.

The environmental surveillance program outlined in DOE Order 5400.1 requires monitoring of terrestrial and aquatic foodstuffs, soil and sediment, surface water, and groundwater. With respect to groundwater, DOE Order 5400.1 requires that "ground waters that may potentially be affected by DOE operations be monitored to determine and document the effects of such operations on groundwater quality and quantity and to demonstrate compliance with applicable Federal and State laws and regulations" (U.S. Department of Energy 1988).

DOE Order 5400.1 recommends that groundwater monitoring at DOE facilities be conducted on-site and in the vicinity of DOE facilities to:

(1) Obtain data for the purpose of determining baseline conditions of ground-water quality and quantity;

(2) Demonstrate compliance with and implementation of all applicable regulations and DOE orders;

(3) Provide data for early detection of groundwater pollution or contamination;

(4) Identify existing and potential groundwater contamination sources and to maintain surveillance of these sources; and

(5) Provide data upon which decisions can be made concerning land disposal practices and the management of groundwater resources.

In addition to the above listed general requirements, DOE Order 5400.1 also contains recommendations regarding monitor-well construction and location, groundwater sampling frequency, sampling and analytical methods, sample sizes, and methods of sample preservation.

Order 5400.2A, "Environmental Compliance Issue Coordination," 1-31-89

Requires coordination of environmental issues that are of significance to DOE, including groundwater protection.

Order 5400.3, "Hazardous and Radioactive Mixed Waste Management," 2-22-89

Requires all DOE hazardous and radioactive mixed wastes be managed according to the requirements of Subtitle C of RCRA and the Atomic Energy Act, respectively. Also requires that groundwater monitoring systems be established at hazardous and radioactive mixed waste facilities in accordance with the standards of 40 CFR 264, Subpart F or 40 CFR 265, Subpart F.

Order 5400.4, "Comprehensive Environmental Response, Compensation, and Liability Act Program," 10-6-89

Requires evaluation of geology, hydrology, and hydrogeology when considering remedial alternatives under CERCLA.

Order 5400.5, "Radiation Protection of the Public and the Environment, " 2-8-90.

Requires monitoring of effluents to the environment, including groundwater discharge, to ensure the radiation doses to the public are maintained as low as reasonably achievable, consistent with prescribed dose standards.

Order 5400.xy, "Radiological Effluent Monitoring and Environmental Surveillance," 9-14-88

Requires groundwater monitoring for environmental surveillance and consultation with state and regional USEPA offices to determine site specific requirements for all groundwater programs.

Order 5480.1B, "Environment, Safety, and Health Program for DOE Operations," 9-23-86

Outlines environmental, safety, and health protection policies and procedures.

Order 5820.2A, "Radioactive Waste Management," 9-26-88

Requires disposal sites to be selected, designed, operated, closed, and monitored in a manner which protects groundwater resources. Requires monitoring to assure that the effective dose equivalent to any member of the public does not exceed 25 mrem/yr from all sources, including groundwater.

2.3 COMPLIANCE ORDERS, FEDERAL FACILITY AGREEMENTS, AND MEMORANDA OF UNDERSTANDING

As a result of information obtained by officials of TDHE during a Compliance Evaluation Inspection of the Y-12 Plant's past and present waste disposal practices, representatives of DOE signed a Memorandum of Understanding (MOU) on May 26, 1983 with the USEPA and TDHE relating to control of contamination in Bear Creek Valley and requiring that investigative and remedial measures be taken to achieve full compliance with all federal and state pollution control laws. Information provided as a result of the MOU revealed additional environmental problems at the Y-12 Plant and necessitated the establishment of more definite deadlines for pollution abatement and investigation. These issues were presented to DOE in a Complaint and Order issued by TDHE on December 1, 1983. Below is a summary of the salient items included in the MOU and the Complaint and Order that pertain to and impact the Y-12 GWPP.

Memorandum of Understanding, 5-26-83

Item X of the MOU requires DOE to investigate the hydrologic characteristics of the Bear Creek Valley disposal areas, the S-3 Ponds, and the Chestnut Ridge Sediment Disposal Basin. Item XI of the MOU requires DOE to prepare a comprehensive monitoring plan for surface water and groundwater of the Y-12 Plant, including all sampling locations and monitored parameters.

Complaint and Order, 12-1-83

Although the Complaint and Order does not specifically require characterization of site hydrogeology, it does contain sections which touch on groundwater issues. Item 2 of the Complaint and Order requires that DOE immediately cease further contamination of groundwater by the disposal of solid wastes in the current Burial Ground Disposal Pits. Item 6 requires DOE to submit a written proposal and schedule, along with supporting data and rationale, for remedial action for the Bear Creek watershed area.

A Federal Facility Agreement (FFA) for the environmental restoration of the Oak Ridge Reservation is currently being negotiated by DOE with the USEPA and the TDHE. Although not in force at this time, the intent of the FFA is to coordinate the DOE CERCLA and RCRA obligations. A wide range of environmental issues and actions at the Y-12 Plant, among them groundwater protection, will be impacted when the FFA is finalized.

2.4 GUIDANCE DOCUMENTS

The following are the applicable guidance documents maintained and utilized by the Y-12 Plant GWPP. They are categorized by the issuing agency or organization and intended to display current guidance actively used by the GWPP, not a comprehensive list of all available documents. When the list is updated, noncurrent guidance will be removed.

USEPA

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, Region IV, Athens, Georgia, April 1, 1986

RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD), OSWER-9950.1, September 1986

Guidelines for Groundwater Classification under the USEPA Groundwater Protection Strategy, Office of Groundwater Protection, December 1986

Underground Storage Tank Corrective Action Technologies, USEPA 625/6-87/015, January 1987

RCRA Facility Investigation (RFI) Guidance, Volumes I - IV, OSWER Directive 9502.00~6C, July 1987

RCRA Comprehensive Groundwater Monitoring Evaluation Document (RCRA Groundwater Monitoring Systems), RCRA Enforcement Division, March 1988

Guidance for Conducting Remedial Investigations Under CERCLA, OSWER Directive 9335.3-01, March 1988

State of Tennessee

Policy on Cleanup Levels for Gasoline and Other Petroleum Hydrocarbons (in Soil and Groundwater), TDHE Division of Groundwater Protection, March 18, 1987, Policy UST-001

DOE

Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells, GJ/TMC-08 (Second Edition) UC-70A, October 1985

Martin Marietta Energy Systems, Inc.

Environmental Surveillance Procedures Quality Control Program, ESH/Sub/87/21706/1, February 1989

3. MONITORING STRATEGY

This chapter outlines monitoring strategies to be followed to comply with all appropriate and relevant regulations. Section 3.1 is based on a monitoring approach outlined by CH_2M Hill (1988). Sections 3.2 through 3.6 are based on monitoring strategies developed by Geraghty and Miller (1990) for the Comprehensive Groundwater Surface Water Monitoring Plan for the Y-12 Plant.

3.1 ENVIRONMENTAL SURVEILLANCE

Environmental surveillance monitoring activities are designed to complement the site-specific, RCRA- or CERCLA-guided groundwater monitoring conducted throughout the Y-12 complex. Environmental surveillance activities are directed principally toward perimeter and offsite monitoring. In contrast to the site-specific groundwater monitoring activities, the specific objectives of environmental surveillance activities are to provide data to establish baseline conditions, to detect migration of contaminants outside operational areas of facilities, and to facilitate determination of the impact of the Y-12 Plant on the public health and environment.

The technical objectives of site-specific groundwater monitoring programs are compatible with all appropriate RCRA, CERCLA, and State of Tennessee regulations. While the technical approach of environmental surveillance monitoring is also consistent with these regulations, it also addresses additional objectives specified in DOE Order 5400.1, that pertain to determination of baseline conditions of groundwater quantity and quality and to facilitywide integration of hydrogeological data.

To address the objectives of facilitywide integration, base program, and assessment, a comprehensive environmental surveillance plan has been proposed for the entire Oak Ridge Reservation (ORR), with special emphasis on the three DOE facilities (CH_2M Hill, 1988). Within the Y-12 Plant area, 83 existing groundwater monitoring wells have been identified for potential incorporation into an environmental surveillance monitoring network. In addition, new perimeter monitoring wells and well clusters are proposed by CH_2M Hill to adequately monitor the perimeter of the Y-12 complex. Other issues addressed in the comprehensive environmental surveillance plan include groundwater quality parameters and well sampling frequency.

3.2 RCRA COMPLIANCE

The RCRA regulations establish different (but similar) groundwater monitoring requirements for two categories of TSD facilities; interim status facilities, and permitted facilities. Additionally, groundwater monitoring requirements for sites covered by the 3004(u) provision of the Hazardous and Solid Waste Ammendments (HSWA) have been established. The basic monitoring requirements for each category are discussed in the following sections.

3.2.1 Interim Status Groundwater Monitoring Programs

Groundwater monitoring during interim status is conducted to ensure that the impact of waste-management activities is monitored and evaluated until a hazardous-waste permit for the site is issued, whereupon the monitoring programs outlined in the permit are implemented. To achieve this goal, the regulations establish a two-stage monitoring program designed to detect (detection monitoring) a contaminant release, and characterize

the extent, rate of migration, and concentration distribution of hazardous waste and hazardous waste constituents released from the site (assessment monitoring).

Detection Monitoring

Detection monitoring is the first phase of the interim status groundwater monitoring program and must be conducted during the active life of the TSD unit (including the post-closure care period for disposal units) until a permit for the site is issued, provided that no groundwater contamination is detected. After receiving a permit, detection monitoring at the site is continued, but must be conducted in accordance with the requirements for permitted facilities, which differ slightly from the interim status detection monitoring requirements.

During the first year of the interim status detection monitoring, background concentrations of all the required constituents are established through quarterly sampling of wells at the site (minimum of one upgradient well and three downgradient wells). At the end of the first year, sampling of all wells is required on a less frequent schedule, the groundwater quality parameters are monitored annually, and the contamination indicators are monitored at least semi-annually.

Each time samples are analyzed for the contamination indicators, the results must be statistically compared to their respective background concentrations established during the first year. The regulations stipulate that Cochran's Approximation of the Behrens-Fisher (CABF) Student t-test be used for statistical comparisons. If a statistically significant increase of any of the indicator parameters is determined in wells down-gradient of the site, and subsequently confirmed, then assessment monitoring is initiated as the second phase of the monitoring program.

Assessment Monitoring

The goal of interim status assessment monitoring is the determination of the rate and extent of migration, and the concentration of hazardous waste or "hazardous-waste constituents" in groundwater at the site. Hazardous-waste constituents are those constituents listed in Appendix VII to Part 261 of 40 CFR and should not be confused with the more comprehensive list of "hazardous constituents" contained in Appendix IX to Part 261. The distinction between these two lists is important and underscores the purpose of assessment monitoring, which is to provide information to support future decisions regarding the need for and extent of corrective action; characterization of contaminant plumes in terms of Appendix IX constituents is developed through the permitting process.

Assessment monitoring may be triggered from detection monitoring as discussed in the preceding section, or may be initiated from the outset at sites where groundwater contamination is suspected, or known to be present. In either case, assessment monitoring must be conducted quarterly in accordance with a Groundwater Quality Assessment Plan (GWQAP). The GWQAP must specify the monitor-well network, sampling and analysis procedures, procedures for data evaluation, and a schedule of implementation. Each year, the results of the assessment monitoring program are summarized in a Groundwater Quality Assessment Report (GWQAR) submitted to the TDHE. The GWQARs for sites associated with the Y-12 Plant are also used as the forum to propose changes and refinements to the assessment monitoring programs at each respective site.

3.2.2 Permit Required Groundwater Monitoring

By November 1988, new or existing interim status TSD units at the Y-12 Plant must be issued a Part B operating or post-closure permit. Operating TSD units must have permits during the active life of the facility, including the closure period, and interim status units that were closed after July 26, 1982 must have permits during the post-closure care period. The Part B permit specifies the applicable groundwater monitoring activities that will be implemented to ensure that any contamination of the uppermost aquifer as a result of a release from the TSD unit is detected, the degree of the release is evaluated, and that corrective action is initiated when such contamination threatens human health or the environment.

To achieve these goals, the regulations establish a three-stage program consisting of detection monitoring, compliance monitoring, and corrective-action monitoring. These programs are graduated such that the level of monitoring effort is progressively increased as the impact of a contaminant release becomes better understood. Thus, detection monitoring is initially implemented. If a contaminant release is detected, and confirmed, compliance monitoring is initiated to monitor the severity of the release, and if pre-determined concentration limits are exceeded, corrective-action monitoring is initiated to determine both the extent of the release and the effectiveness of the corrective actions implemented to mitigate the release. Statistical analysis procedures are the mechanisms which "trigger" the progression from one program to the next.

For interim status sites, groundwater quality conditions at the time of permit application determine which of the three monitoring programs will be implemented. If no contamination has been detected at the site, then the permit application must outline a detection monitoring program. However, if contamination of the uppermost aquifer at the site has been confirmed during interim status, then details regarding either compliance monitoring or corrective-action monitoring must be specified in the permit application; the degree of contamination will determine which of the two programs will be implemented upon permit approval.

Detection Monitoring

For new hazardous waste TSD units and interim status units where no ground-water contamination has been detected, the site-specific elements of a detection monitoring program meeting the requirements for permitted facilities are specified in the Part B permit. The goal of detection monitoring is to determine whether the site has leaked, or is leaking contaminants into the uppermost aquifer in quantities sufficient to cause a significant change in groundwater quality (U.S. Environmental Protection Agency, 1985).

In general, detection monitoring for permitted facilities requires monitoring downgradient of the site for a select set of indicator parameters specified in the permit. The data are statistically compared to their respective background values established in background wells over an initial period of one year. If a statistically significant change in the level of any monitored parameter is detected and confirmed, then sampling for Appendix IX constituents must be immediately conducted to enable a complete chemical characterization of the contaminant release. Upon completion of this characterization, monitoring at the site then progresses to compliance monitoring (U.S. Environmental Protection Agency, 1985).

Compliance Monitoring

The goal of compliance monitoring is to determine whether leakage of Appendix IX constituents into the uppermost aquifer has exceeded acceptable levels specified in the Part B permit as part of the Groundwater Protection Standard (GWPS). The GWPS is one of the most important aspects of the hazardous-waste permit. It not only provides the framework for compliance monitoring, but also defines the action levels and clean-up standards for corrective-action. A GWPS consists of four elements:

(1) A list of all the Appendix IX constituents present in groundwater at the site;

(2) The maximum allowable concentration of each constituent defined by either the background level of the constituent, the maximum contamination level (MCL) established by the USEPA (if available), or an alternate concentration limit (ACL) that has been demonstrated to not pose a substantial present or potential threat to human health or the environment;

(3) The location where the GWPS is applied (the point of compliance) and hence where compliance monitoring is conducted; and

(4) The period during which the GWPS applies (the compliance period) which is equal to the active life of the facility including the closure period (U.S. Environmental Protection Agency, 1985).

For permitted TSD units, the GWPS is established through a permit modification after a contaminant release has been detected and confirmed, and Appendix IX sampling to initially characterize the release has been completed. For interim status facilities, however, the GWPS is established in the initial permit application, not through a subsequent permit modification. Part B permit applications for interim status sites which have released contaminants to the uppermost aquifer must contain a characterization of any existing plume of contamination which identifies the maximum concentrations of all the Appendix IX constituents within the plume. The GWPS for interim status facilities is therefore based upon the Appendix IX plume-characterization data collected prior to permitting.

Compliance monitoring is essentially a program of routine monitoring conducted to ensure that the facility is in compliance with its GWPS. During compliance monitoring, all wells at the point of compliance are sampled quarterly and analyzed for all of the constituents included in the sites GWPS. In addition, all compliance point wells must be sampled at least annually and analyzed for the Appendix IX constituents to determine if additional hazardous constituents have been released from the site.

After each quarterly monitoring event, the data must be statistically analyzed in accordance with an approved statistical procedure. If statistical analyses of the data indicate that the concentration limits specified in the GWPS have been exceeded in any well at the point of compliance, a corrective-action program must be initiated to bring the facility back into compliance with its GWPS (U.S. Environmental Protection Agency, 1985).

Corrective-Action Monitoring

Under RCRA, groundwater monitoring must be conducted in conjunction with corrective action to demonstrate the effectiveness of the corrective actions. However, the regulations governing corrective-action monitoring are far less detailed than those concerning either detection or compliance monitoring.

Although very generalized, the corrective-action regulations give some indications as to minimum corrective-action monitoring requirements. For one, the regulations state that corrective-action monitoring may be based on compliance monitoring. This would suggest that, as required in compliance monitoring, annual Appendix IX analyses of samples collected from compliance point wells may be required for corrective-action monitoring. In addition, because the RCRA regulations require corrective action to address contaminated groundwater located between the point of compliance and the downgradient property boundary, (and beyond), periodic sampling of additional wells not located at the point of compliance may also be required. However, it would not likely be necessary to analyze samples from these wells for the complete suite of Appendix IX constituents; only those hazardous constituents which triggered corrective action (i.e. exceeded their respective concentration limits specified in the sites GWPS) would warrant monitoring.

3.2.3 Groundwater Monitoring at SWMUs

In response to HSWA, the USEPA developed technical guidance regarding contamination investigations at SWMUs subject to regulation under RCRA section 3004(u). Initial drafts of these guidance documents outline a three-phase program consisting of a RCRA Facility Assessment (RFA), a RCRA Facility Investigation (RFI), and the selection and implementation of Corrective Measures (CM) (U.S. Environmental Protection Agency 1986). Although groundwater monitoring may be required in some instances, a RFA usually involves a "desk top" review of existing information to identify all SWMUs at the facility and those SWMUs needing further investigation under an RFI.

Groundwater monitoring is required at a SWMU if, based on the results of the RFA, it is determined that contaminants have been, or are suspected to have been released to the groundwater system underlying the SWMU. Specific details regarding the monitoring program, including monitored parameters, monitoring frequency and duration, and the monitor-well network, must be specified in an RFI work plan submitted to appropriate regulatory agency for approval.

No state or federal regulations have been promulgated regarding the specific requirements of RFI groundwater monitoring. Guidance documents prepared by the USEPA indicate that an initial monitoring phase will be required to determine if a contaminant release has occurred. Further investigation may be terminated if the results indicate that a release to the groundwater system has not occurred. However, if a release has occurred, then subsequent monitoring phases will be required to determine the chemical composition and the areal and vertical extent of the contaminant release, as well as the rate of contaminant migration (U.S. Environmental Protection Agency, 1986).

3.3 CERCLA COMPLIANCE

As of this writing, no state equivalent to the CERCLA regulations have been promulgated; federal CERCLA regulations are contained in 40 CFR Part 300. While the RCRA regulations outline in detail the requirements for specific groundwater monitoring programs, CERCLA regulations include groundwater monitoring as one of several aspects of a broadly-scoped Remedial Investigation/Feasibility Study (RI/FS). The RI/FS process represents a two-pronged approach to contamination assessments at CERCLA sites. The remedial investigation is the data collection mechanism for the feasibility study effort. Accordingly, the remedial investigation emphasizes data collection and site-characterization (monitoring).

Like the RFI process for SWMUs, the specific requirements for groundwater monitoring during a CERCLA remedial investigation are not explicitly defined in the regulations, but

are recommended in guidance documents prepared by the USEPA. Thus, specific details regarding monitored parameters, monitoring frequency and duration, and the monitor-well network are developed on a site-by-site basis, and are contained in a work plan submitted to appropriate regulatory agency for approval before the remedial investigation is initiated. When a sufficient amount of data have been generated to support the feasibility study, groundwater monitoring efforts are reevaluated.

3.4 NONHAZARDOUS SOLID WASTE DISPOSAL FACILITIES COMPLIANCE

Under the draft TDHE solid waste regulations, groundwater monitoring is required at all new and existing Class I, II, and III solid-waste disposal facilities (SWDFs) (see Section 4.1.2). Monitoring at Class IV SWDFs is not required unless specifically requested by the TDHE and groundwater monitoring requirements for Class V and VI SWDFs are not currently specified in the draft regulations. The level of monitoring effort is dependent upon the type of facility with the most stringent monitoring required at Class I SWDFs and the least stringent at Class III sites.

The draft solid waste regulations, like the regulations governing RCRA-regulated TSD facilities, specifically outline minimum standards for groundwater monitoring. These standards require each SWDF to have a minimum of three monitor wells (one upgradient, and two downgradient) and a detailed groundwater sampling and analysis plan. In addition, the draft solid waste regulations also share the GWPS and compliance boundary concepts with the RCRA regulations. As with RCRA TSD facilities, conformance with the GWPS is determined at the compliance boundary.

Like the RCRA monitoring programs, monitoring requirements under the draft solid-waste regulations have been structured such that the level of monitoring effort is progressively increased if a contaminant release is suspected. Thus, detection monitoring is initially required to determine if the site has leaked or is leaking contaminants of the groundwater system. If so, assessment monitoring is implemented to characterize the extent of the release.

3.5 UNDERGROUND STORAGE TANKS COMPLIANCE

Like the regulations governing SWMUs and CERCLA sites, few specific requirements for groundwater monitoring have been established for USTs. In general, the UST regulations require groundwater monitoring in only two instances; (1) as one of several acceptable leak detection alternatives, and (2) during site characterization to determine the extent of a release of regulated substances from the UST.

3.5.1 Release Detection Monitoring

Release or leak detection forms a major component of the UST regulations. Owners and operators of all UST systems must comply with release detection requirements within specified time frames. The regulations outline several alternative methods for release detection, including inventory control, manual tank gauging, tank tightness testing, automatic tank gauging, vapor monitoring, groundwater monitoring, interstitial monitoring, or an alternative method approved by the appropriate regulatory agency. Regardless of the type of method or combination of methods employed, however, release detection must be performed at least once every 30 days, unless the UST system complies with several performance standards and monthly inventory control requirements.

If groundwater monitoring is selected as the method of release detection, the following minimum standards are required:

(1) Groundwater must not be more than 20 feet below grade and the hydraulic conductivity of the soils between the UST system and the monitor wells cannot be less than 0.01 centimeters per second;

(2) Monitor wells must be located to intercept the excavated zone around the UST or are as close to it as technically feasible, and must be clearly marked and secured to avoid unauthorized access and tampering;

(3) Monitor wells must be screened to allow entry of the regulated substance into the well under both high and low water-table conditions, and the screened portion of the well must be designed to prevent migration of soil or filter-pack materials into the well;

(4) Monitor wells must be sealed from the ground surface to the top of the filter pack; and

(5) Design of the monitor wells must accommodate the detection of at least one-eighth of an inch of free product.

To ensure compliance with the above listed standards and to establish the number and positioning of wells, the UST regulations require a preliminary site assessment of the area within and immediately below the UST system. The regulations further require the owner/operator to maintain records for at least one year of the results for sampling, testing, or monitoring.

3.5.2 Site Characterization Monitoring

Upon confirmation of a release at an UST, an initial site characterization is required to obtain information regarding the nature of the release. Based upon this initial information, a complete characterization of the release is required if any of the following conditions are observed;

(1) There is evidence that groundwater (supply) wells have been affected by the release;

(2) Recoverable free product is present;

(3) There is evidence that contaminated soils may be in contact with groundwater; or

(4) The TDHE requests a full characterization of the release.

Specific details regarding the monitoring activities that will be implemented to determine the extent of the release must be submitted to the TDHE in an Environmental Assessment Plan (EAP). An EAP may be considered analogous to a GWQAP prepared for interim status TSD units, and like a GWQAP, the EAP must specify the number and location of wells, monitored parameters, and monitoring frequency that will be implemented to determine the extent of the release. Results of the EAP must be summarized in a Environmental Assessment Report (EAR).

Upon review of the EAR, the TDHE may require corrective action to remove dissolved product from the groundwater. However, it is important to note that corrective action may be requested by the TDHE at any time during the site characterization. Further groundwater monitoring may therefore be requested by the TDHE as a means of evaluating the effectiveness of the corrective action.

3.6 APPROACH FOR REGULATORY COMPLIANCE

A review of the preceding discussion of regulatory programs illustrates that the RCRA and non-hazardous SWDF regulations are very similar in their approach to ground-water monitoring and that these two regulatory programs provide far more detailed monitoring requirements than any of the regulations governing SWMUs, CERCLA sites, and USTs. Due to these similarities, and the fact that the SWDF regulations are still in draft form, the RCRA monitoring programs will be used as the framework for regulatory compliance at the Y-12 Plant. Thus, four basic monitoring programs will be conducted: detection, assessment, compliance, and corrective action monitoring.

The relationship of the monitoring programs to the various waste sites at the Y-12 Plant suggest that detection monitoring will be conducted only at RCRA-regulated TSD units and SWDFs, where appropriate based upon groundwater quality conditions and the permit status of each site. Assessment monitoring, which includes both monitoring at RCRA interim status sites and at SWDFs, will be expanded in scope to accomplish the objectives of monitoring at SWMUs, USTs, CERCLA sites, and to comply with DOE orders. In its expanded form, assessment monitoring will be the principal mechanism for the collection of monitoring data at all leaking waste sites associated with the Y-12 Plant. Compliance monitoring will only take place at RCRA regulated units. Corrective action monitoring will be conducted during the design and implementation of corrective actions and will essentially be an evolved form of assessment monitoring.

3.6.1 Detection Monitoring

Detailed requirements for detection monitoring are outlined only for RCRA TSD units and SWDFs, but the monitoring requirements for each respective site differ slightly. However, reconciliation of these differences will not be addressed because (1) the fundamental objectives are the same although the details may vary, and (2) DOE should be able to resolve differences through negotiations with the TDHE when the SWDF regulations become effective.

Detection monitoring at RCRA-regulated units has been effectively managed in the past through implementation of the Y-12 Plant "Base Program." Developed by Energy Systems in 1986, the Base Program essentially represents a standardized suite of monitored parameters based upon RCRA requirements that has proven effective in maintaining a consistent technical approach to groundwater sampling activities at all hazardous and non-hazardous waste sites at the Y-12 Plant for which detection monitoring is appropriate. The suite of monitored parameters included in the first year of the Base Program comply with those for interim status detection monitoring, however, the Base Program incorporates total uranium and omits herbicides and pesticides not utilized at the Y-12 Plant and not detected in groundwater at the Plant. In addition, the Base Program includes an optional suite of VOCs.

3.6.2 Assessment Monitoring

Assessment monitoring is presently being implemented at five of the eight RCRA-regulated TSD units at the Y-12 Plant and has been proven effective. This program will be expanded to satisfy monitoring objectives at SWMUs, USTs, and CERCLA sites and comply with DOE orders. Expansion of the program will facilitate monitoring of clusters of sites where dictated by overlapping plumes and the mechanics of the flow system. Surface water monitoring stations, including springs, will be identified for each site or cluster of sites to determine the effect of contamination that may be discharged from the groundwater system. Exit pathways will also be monitored to comply with DOE orders. This will focus on the Maynardville Limestone which acts as the primary hydrogeologic drain for Bear Creek Valley, UEFPC, and portions of Chestnut Ridge.

The source identification component will be implemented at SWMU and CERCLA sites where soil sampling has indicated releases have occurred. If a release cannot be attributed to the site, it will no longer be subject to monitoring. Annual reports presenting analytical data and interpretations will be submitted for each hydrogeologic regime. These reports will take the form and function of the GWQARs presently submitted for the RCRA interim status sites undergoing assessment monitoring. The importance of the role played by assessment monitoring in the characterization of groundwater and surface water data from the Y-12 Plant is paramount.

3.6.3 Compliance Monitoring

Compliance monitoring is applicable only to permitted RCRA TSD units; there is no equivalent monitoring program currently defined under the state or federal regulations governing groundwater monitoring at SWMUs, CERCLA sites, USTs, or non-hazardous SWDFs. Moreover, the RCRA regulations governing compliance monitoring explicitly outline minimum performance standards. Thus, the site-specific details for compliance monitoring fulfilling all regulatory requirements will be provided in the Part B operating or post-closure permits for those sites for which this program is applicable. Appropriate RCRA sites include those "triggered" into compliance monitoring from detection monitoring, and those sites which "return" to compliance monitoring from corrective-action monitoring.

3.6.4 Corrective Action Monitoring

As noted previously, corrective-action monitoring is mandated only by the regulations governing permitted RCRA TSD units which, aside from providing the data needed to evaluate the effectiveness of the corrective action efforts, define no other specific performance standards. This lack of specific regulatory requirements, however, imparts a significant degree of flexibility to the technical approach for corrective-action monitoring. Furthermore, the absence of detailed regulatory controls facilitates development of a comprehensive corrective-action monitoring program capable of evaluating the overall effectiveness of concerted site-specific corrective actions throughout each Bear Creek hydrogeologic regime at the Y-12 Plant.

Corrective-action monitoring will likely incorporate aspects of compliance monitoring and assessment monitoring, including monitoring at the point of compliance for RCRA sites, an integrated monitor well network between sites (based upon existing assessment well network), a standardized suite of monitored parameters and constituents, and a quarterly sampling frequency. Annual reports summarizing the results of the corrective-action monitoring program will also be needed to comply with RCRA regulations.

4. SITE DESCRIPTIONS

The following sections provide an overview of the hydrogeological setting of the Oak Ridge Y-12 Plant and of the types of waste management sites at the Y-12 Plant, and are adapted largely from the Comprehensive Groundwater and Surface Water Monitoring Plan for the Y-12 Plant prepared by Geraghty and Miller (1990). There are over 100 sites at the Y-12 Plant at which hazardous or non-hazardous wastes are presently or have previously been managed. The types of waste-management units include above and below-ground storage tanks, landfills, surface impoundments, waste piles, land treatment areas, and scrap yards.

4.1 HYDROGEOLOGIC FRAMEWORK

A general discussion of hydrogeologic conditions in the vicinity of the Y-12 Plant is provided in the following sections. The purpose of this discussion is to furnish the reader with a basic understanding of the hydrogeologic system at the Y-12 Plant; it is not intended as a definitive description of hydrogeologic conditions. Numerous papers, articles, and reports have been prepared which contain more detailed discussions of various aspects of the Y-12 Plant hydrogeology. A list of many of these reports is provided in Appendix A.

4.1.1 Site Geology

The Y-12 Plant is located within the southern part of the Valley and Ridge physiographic province, which is characterized by narrow elongated ridges and valleys that trend in a northeast-southwest direction. The ridges are typically formed on resistant sandstones, siltstones, and siliceous limestones whereas the valleys are commonly underlain by less resistant shales and soluble carbonates. Structurally, the Valley and Ridge province is characterized by thrust faults and subsidiary faults that are part of a major decollement of the Southern Appalachian thin-skinned orogenic thrust belt. Movement along thrust faults in the region towards the northwest has placed older stratigraphic sequences on top of younger ones.

Most of the waste management units at the Y-12 Plant are located in Bear Creek Valley (BCV), which is flanked to the northwest by Pine Ridge and to the southeast by Chestnut Ridge. Pine Ridge is formed by Cambrian shales and siltstones of the Rome Formation (Figure 4-1, in pocket), which represent the oldest geologic strata in the vicinity of the Plant. Conformably overlying the Rome Formation are Cambrian limestones, shales, and siltstones of the Conasauga Group which underlie BCV. The strata of the Conasauga Group have been divided, based on lithology, into six formations. These formations are, from oldest to youngest, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale, and Maynardville Limestone. Cambro-Ordovician dolostones of the Knox Group, which unconformably overly the Conasauga Group, form Chestnut Ridge. A geologic column illustrating the stratigraphic relationships between geologic units at the Y-12 Plant is provided in Figure 4-2

Bedrock units throughout the Y-12 area generally are overlain by unconsolidated deposits of varying thickness consisting of weathered bedrock that is referred to locally as residuum, man-made fill, alluvium, and colluvium. Residuum comprises a majority of the unconsolidated materials in this area, and is especially well developed on Chestnut Ridge.

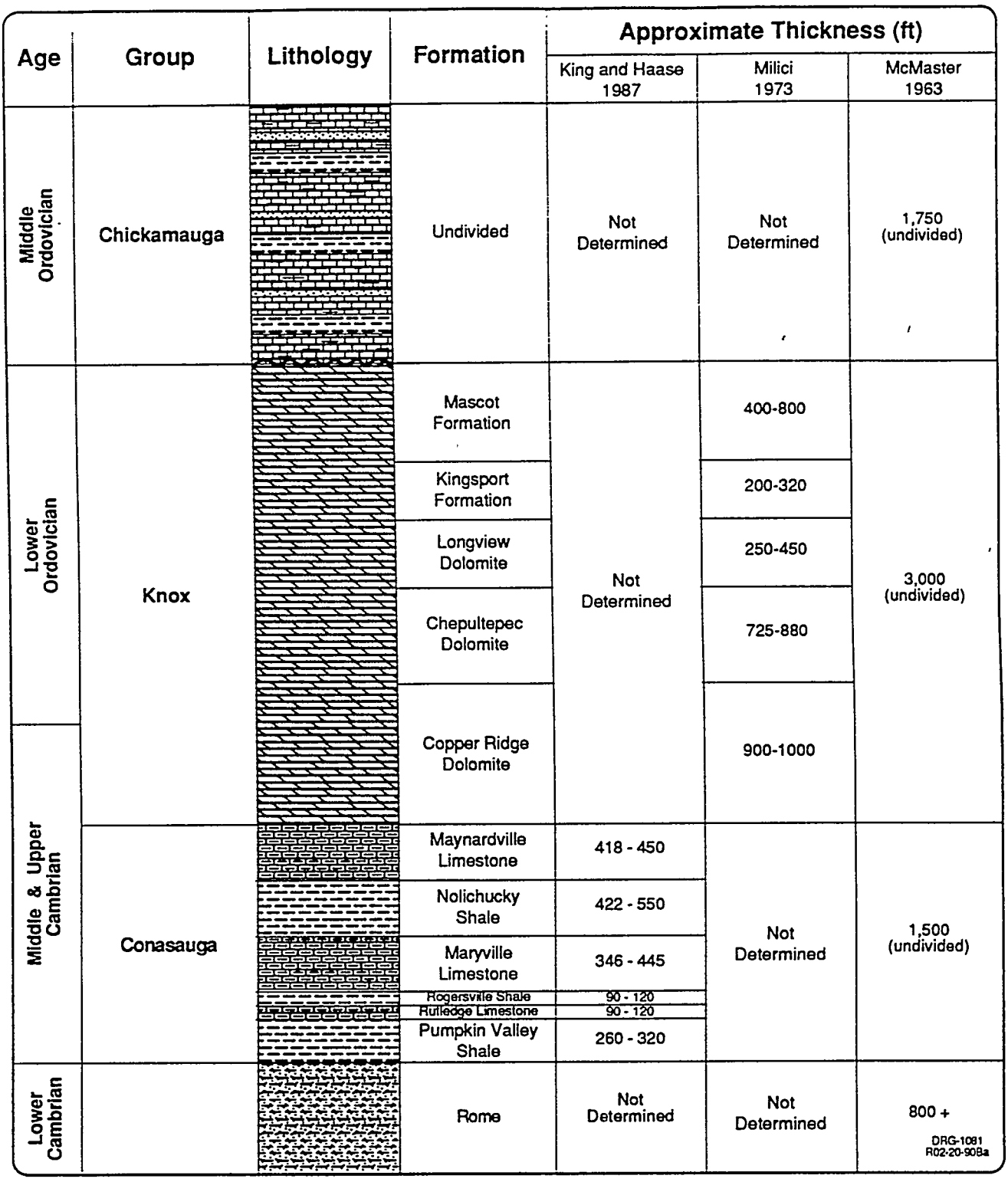

Figure 4-2. Stratigraphic column of bedrock units in the vicinity of the Oak Ridge Y-12 Plant (from Geraghty and Miller 1990).

Strike and dip of bedding in the Y-12 area are generally N55°E and 45°SE, respectively. However, at any given location, the strike may range from N35° to 65°E and the dip may vary from 30°SE to nearly vertical (Rothschild et al., 1984; King and Haase, 1987). The dominant structural features at the Y-12 Plant are the Copper Creek and White Oak Mountain thrust faults. The Copper Creek Fault dips 25° to 30°SE at the ground surface, and is exposed southwest of BCV (Figure 4-1, in pocket). The White Oak Mountain Fault in the Oak Ridge area is a zone of faulting in which a number of individual thrust faults have juxtaposed various stratigraphic units. This fault zone is exposed northwest of Pine Ridge. A geologic cross-section illustrating the regional structural framework is provided in Figure 4-3.

4.1.2 Hydrogeological Regimes

The hydrogeologic system at the Y-12 Plant has been subdivided, based upon topography, surface-water drainage, and groundwater flow patterns, into three distinct hydrogeologic regimes (Figure 4-4, in pocket). This approach has two basic advantages. First, it provides a basis to unify monitoring efforts at the Y-12 Plant waste sites into more manageable groups for planning and reporting purposes. Second, it allows for monitoring efforts to be tailored to the hydrogeologic characteristics of each regime.

The topography of the Y-12 Plant area provides the basis for the first and most obvious subdivision of the hydrogeologic system. The Y-12 Plant and a majority of the waste sites associated with the Plant lie in Bear Creek Valley (BCV). Other waste-disposal sites are located on Chestnut Ridge. Although hydraulically interconnected to some degree BCV and Chestnut Ridge both have distinctly different hydrogeologic characteristics. Thus, Chestnut Ridge has been separated from BCV as a distinct hydrogeologic regime.

Upper East Fork Poplar Creek and Bear Creek Hydrogeologic Regimes

Surface-water drainage characteristics and groundwater flow patterns provide the basis for subdividing the hydrogeologic system in BCV. Two watersheds are present in BCV; the Upper East Fork Poplar Creek (UEFPC) watershed and the Bear Creek watershed. The topographic divide between these two watersheds is located near the west end of the Y-12 Plant. A corresponding groundwater flow divide has also been documented. Based upon these surface water and groundwater flow divides, BCV has been divided into the Bear Creek hydrogeologic regime and the UEFPC hydrogeologic regime.

The hydrogeologic system in the UEFPC and Bear Creek hydrogeologic regimes can be conceptualized as a single interconnected aquifer with markedly different hydraulic properties which are attributable to contrasting lithologies and structural features. The aquifer generally is composed of an upper zone of weathered unconsolidated material overlying a bedrock zone. Although the unconsolidated zone is sometimes more permeable than the bedrock zone, there is no sharp discontinuity of permeability between them and both respond in the same general way in terms of water-level fluctuations and the ground-water flow directions.

Groundwater in the unconsolidated zone occurs in residuum, alluvium, colluvium, and man-made fill. Because of the extensive re-working of the land surface associated with construction of the Y-12 Plant, man-made fill is especially predominant in the UEFPC Watershed. The fill material is generally more permeable that the surrounding residuum and provides conduits for water transport in the upper unconsolidated zone (Battelle Columbus Division, 1987). It is not certain to what degree the re-worked land surface underlying the Y-12 Plant has affected surface water and groundwater interactions.

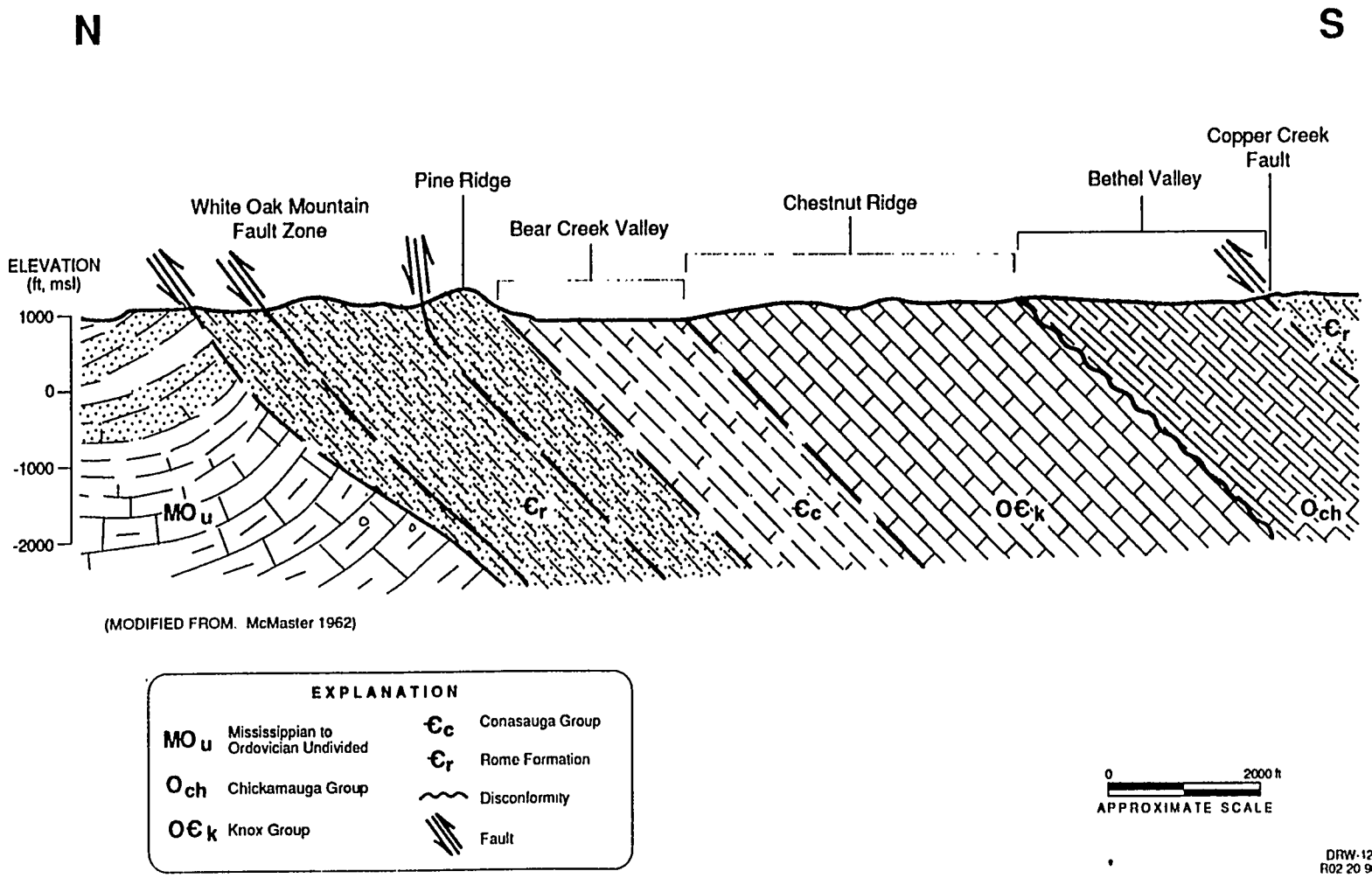

Figure 4-3. Geologic cross section of the Oak Ridge Y-12 Plant (from Geraghty and Miller 1990).

Due to the location of the waste-management units and the nature of the flow system underlying these units, two bedrock components of the aquifer system underlying the UEFPC and Bear Creek hydrogeologic regimes are of particular interest with respect to ground-water monitoring at the Y-12 Plant. These components are; (1) the primary shale formations of the Conasauga Group (Maryville Limestone and the Nolichucky Shale), and (2) the Maynardville Limestone.

Many of the waste-management units located in the UEFPC and Bear Creek hydrogeologic regimes are underlain by either the Maryville Limestone (which, in the Oak Ridge area, is comprised predominantly of shale interbedded with limestone) the Nolichucky Shale, or both. Aquifer pumping tests conducted to determine the hydraulic properties of these formations have been typified by very low yields (usually less than five gallons per minute) and ellipsoidal water-level cones of depression, elongated parallel to geologic strike. These observations have been interpreted by several investigators to reflect the low permeability and strong anisotropy of the formations where bedding planes provide preferred ground-water flow paths along strike and down dip.

Several waste-management units located in the UEFPC and Bear Creek hydrogeologic regimes are underlain by the Maynardville Limestone, which is the principal water-bearing formation within the Conasauga Group in BCV. The water-bearing capacity of the Maynardville has been greatly enhanced by solution-enlargement of structural and stratigraphic features such as fractures, joints, and bedding planes. Evidence of the solution cavity system in the Maynardville can be observed in outcrops in Bear Creek and inferred from drilling logs. This solution cavity system is believed to be the major discharge area for shallow and intermediate-depth groundwater within the primary shale formations of the Conasauga Group.

The direction of groundwater flow in BCV is generally towards the two creeks that drain the valley; UEFPC and Bear Creek (Figure 4-5 in pocket). Water level elevation data indicate that a groundwater flow divide is located in BCV near the west end of the Y-12 Plant. Northeast of the divide, groundwater flows towards UEFPC and southwest of the divide, groundwater flows towards Bear Creek. Studies have shown that the solution cavities in the Maynardville Limestone, which underlie these creeks throughout most of BCV, are the major discharge areas for shallow and intermediate depth groundwater moving through the primary shale formations of the Conasauga Group. Groundwater discharge from the Maynardville sustains the flow of Bear Creek, or at times of low flow, moves through the solution cavities underlying Bear Creek (Geraghty & Miller, Inc. 1985a). The hydrologic relationship between the Maynardville Limestone and UEFPC is less well understood due to the primary focus of previous hydrogeologic studies on the Bear Creek hydrogeologic regime and the pronounced influence of water discharged from the plant.

In the low-lying parts of BCV, upward components of groundwater flow are commonly observed in wells screened below 50 ft in the Maryville and Nolichucky formations, as expected from the conceptualization illustrated in Figure 4-6. Downward components of flow have been noted within the Maynardville Limestone between depths of 40 and 200 ft near the headwaters of Bear Creek. This finding supports the hypothesis that the Maynardville has a comparatively high permeability and drains groundwater from adjacent shale formations in BCV.

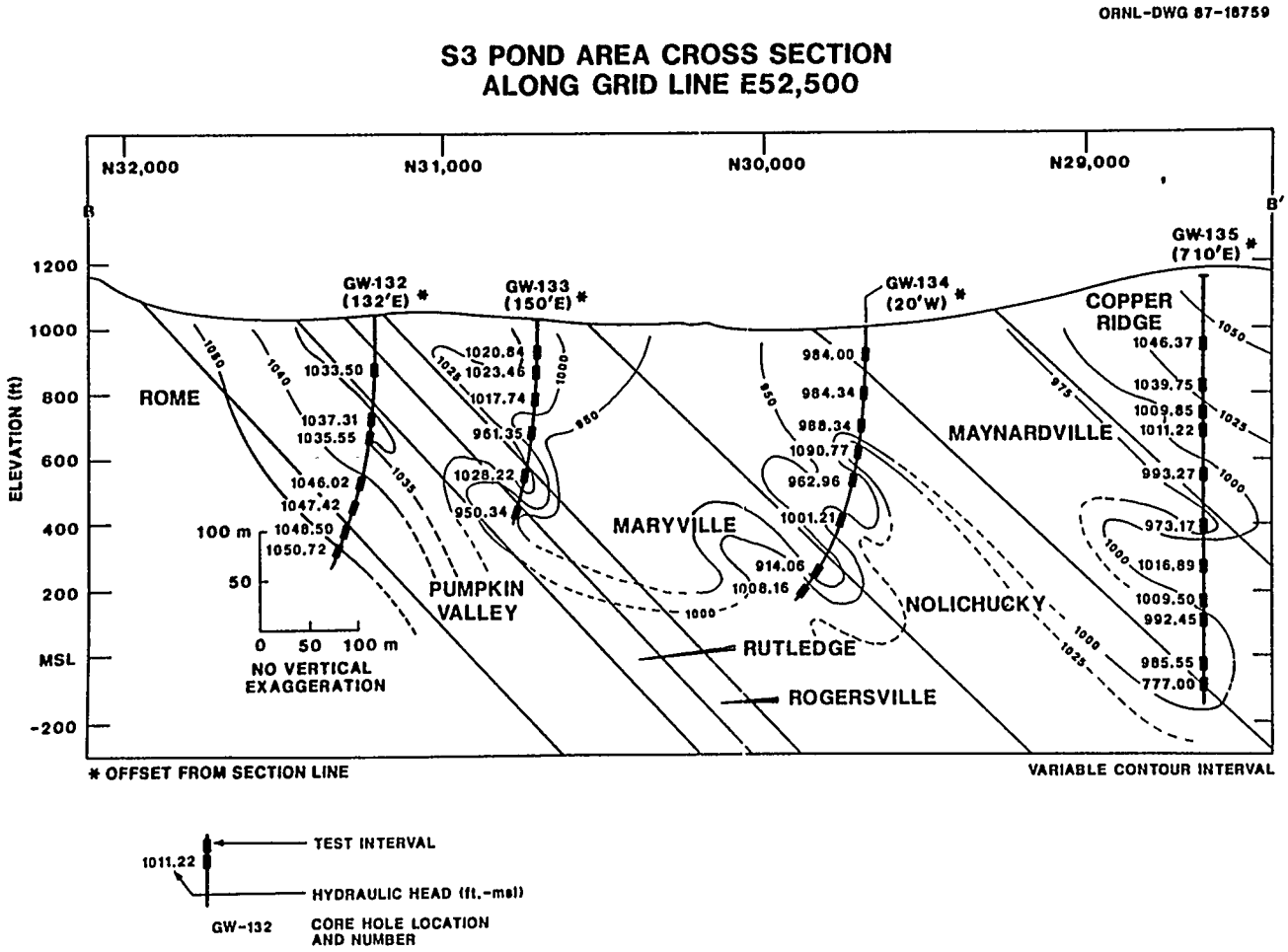

Figure 4-6. Hydrologic cross section of Bear Creek Valley in the vicinity of the S-3 Ponds locality (from King and Haase 1988).

Chestnut Ridge Watershed

Most of the waste-management units on Chestnut Ridge are generally located to the south and southwest of the Y-12 Plant and are underlain with the Knox Dolomite. The Knox Group consists primarily of fractured and jointed dolostones that, like the limestones in the Maynardville Limestone in BCV, have been subjected to considerable dissolution by circulating groundwater. Dissolution along fractures, joints, and bedding planes is predominantly responsible for the porosity and permeability of the formation. Thus, groundwater movement within the Knox Group is largely restricted to these solution-enlarged conduits.

This observation has been substantiated by packer tests conducted on Chestnut Ridge in three core holes aligned approximately along geologic strike. Test intervals within the core holes were selected to correspond with fractured of solutionally altered zones, unaltered sections, or intervals associated with borehole geophysical log anomalies. Results of these tests indicated that lower permeability values generally correlate to unaltered sections of rock, whereas higher values usually represented fractured and/or solutionally altered intervals (King and Haase, 1989).

A conceptualization of the hydrogeologic system underlying Chestnut Ridge indicates that a groundwater flow divide is located approximately beneath the ridge crest (Geraghty and Miller, 1990). The location of the divide influences whether groundwater flows northwest into the Bear Creek and UEFPC watersheds or southeast toward watersheds in Bethel Valley. Actual groundwater flow behavior undoubtedly departs from this conceptualization because of the influence of bedding orientation and secondary openings, such as fractures, joints, and solution cavities.

The distribution of joints, fractures, and solution cavities exert substantial local influence on groundwater flow directions in the Knox Group (Ketelle and Huff 1984). Studies of the joint and fracture patterns on Chestnut Ridge suggest that preferred ground-water flow directions within the upper Knox Group are parallel with and perpendicular to the ridge crest (Law Engineering, 1983).

Springs and stream tributaries are the discharge points for groundwater in the Knox Group. Numerous springs have been observed along the northeastern flank of Chestnut Ridge near the contact between the Maynardville Limestone and the Knox Group. It is likely that some of the groundwater from the Knox is discharged to the Maynardville Limestone in BCV; however, the degree of hydraulic communication between the Knox and the Maynardville has not been fully determined. Topographic maps of the area also note the presence of springs and perennial stream tributaries along the southwestern flank of Chestnut Ridge. The base flow of the tributaries is probably sustained by groundwater discharges from the Knox Group. In addition, groundwater following deeper flow paths in the Knox may discharge to streams and tributaries in Bethel Valley.

4.2 ENVIRONMENTAL SURVEILLANCE SITES

A monitoring strategy for environmental surveillance of groundwater quality at the borders of the Y-12 Plant is presented by CH_2M Hill (1988). The proposed strategy is to incorporate selected existing wells at various RCRA TSD sites and SWMUs into a perimeter monitoring system. The sites selected for incorporation into the environmental surveillance network are ones at the edge of the Y-12 Plant property. Additionally, a series of new monitoring wells was proposed to complete the environmental surveillance network. The proposed network will consist of 83 wells, of which 50 are currently in

place. The CH_2M Hill recommendations are currently under consideration by an Energy Systems Groundwater Implementation Team. The team will define actions to be taken as a result of these recommendations. Changes will be incorporated into the Groundwater Section of the Environmental Monitoring Plans to comply with DOE Order 5400.1.

4.3 HAZARDOUS WASTE SITES

4.3.1 Interim Status RCRA Sites

When the USEPA first issued regulations to implement RCRA, it was recognized that all the hazardous-waste TSD facilities throughout the country could not be permitted simultaneously and that facilities in operation prior the enactment of RCRA could not be expected to immediately comply with RCRA standards. The regulations therefore established an interim status period to allow time for owners/operators to bring their TSD facilities into compliance with RCRA.

There are eight land-based disposal units at the Y-12 Plant which have been granted interim status (Table 4-1). RCRA Part B post-closure permit applications (PCPAs) have been submitted to the TDHE for the S-3 Ponds, Oil Landfarm, Bear Creek Burial Grounds (Geraghty & Miller, Inc., 1988a, 1988b, and 1988c), New Hope Pond (Lee Wan and Associates, Inc., 1989a), the Chestnut Ridge Security Pits (Geraghty & Miller, Inc., 1989), and the Chestnut Ridge Sediment Disposal Basin (Lee Wan and Associates, Inc., 1989b) . PCPAs for the remaining interim status sites (Table 4-1) are currently being prepared. The location of each of these sites is illustrated in Figure 4-7 (in pocket). As shown, one site (New Hope Pond) is located in the UEFPC watershed near the east end of the Y-12 Plant, three sites (S-3 Site, Oil Landfarm, and Bear Creek Burial Grounds) are located in the Bear Creek hydrogeologic regime west of the Y-12 Plant and comprise the the Bear Creek Valley Waste Disposal Area (BCVWDA), three sites (Chestnut Ridge Security Pits, Chestnut Ridge Waste Pile, Chestnut Ridge Sediment Disposal Basin) are located on Chestnut Ridge, and one site (Kerr Hollow Quarry) is located in Bethel Valley.

4.3.2 Permitted RCRA Sites

Unless exempt from permitting requirements, RCRA hazardous-waste Part B permits must be obtained for all new TSD units (operating permits), and interim status units which were not closed by July 26, 1982 (post-closure permits). At this time, operating permits have been obtained for several hazardous-waste treatment and storage facilities at the Y-12 Plant, but no operating or post-closure permits have been issued for any land-based hazardous-waste disposal unit at the Plant.

4.3.3 RCRA Solid Waste Management Units

Since early 1987, efforts to identify all SWMUs at the Y-12 Plant have been in progress. In April of that year, Energy Systems issued a report entitled "Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment (RFA)" which listed many of the SWMUs associated with the Y-12 Plant (Welch, et al., 1987). In 1987, 1988, and 1989, supplemental RFA documents were prepared by Energy Systems which listed additional SWMUs located at the Y-12 Facility (Welch, 1987; Wiggins and Welch, 1988a, 1988b; Murphy, 1989). A list of all the SWMUs for which some degree of contaminant release investigation is currently in progress or is planned is provided in Table 4-2; Locations of these SWMUs in Bear Creek Valley are illustrated in Figure 4-8 and in the UEFPC hydrogeologic regime and Chestnut Ridge in Figure 4-9 (both figures in pocket).

Table 4-1. RCRA Regulated Hazardous-Waste Treatment, Storage, and Disposal Sites at the Oak Ridge Y-12 Plant

Site Location and Name	Interim Status Monitoring Programs						Permit Required Monitoring		
	Detection Monitoring	Assessment Monitoring					Detection Monitoring	Compliance Monitoring	Corrective Action Monitoring
		GWQAP	GWQARs 1986	1987	1988	1989			
Bear Creek Watershed									
S-3 Waste-Management Area *(a)*	N/A	Dec-1986	x	x	x	*(b)*	N/A	TBD *(d)*	TBD *(d)*
Oil Landfarm Waste-Management Area	N/A	Dec-1986	x	x	x	*(b)*	N/A	TBD *(d)*	TBD *(d)*
Bear Creek Burial Grounds Waste-Management Area	N/A	Dec-1986	x	x	x	*(b)*	N/A	TBD *(d)*	TBD *(d)*
UEFPC Watershed									
New Hope Pond	Jan-1986	Jan-1988	—	—	x	*(c)*	N/A	TBD *(d)*	TBD *(d)*
Chestnut Ridge									
Chestnut Ridge Sediment Disposal Basin	Jan-1986	—	—	—	—	—	x	TBD *(e)*	—
Chestnut Ridge Security Pits	Jan-1986	Jan-1988	—	—	x	—	N/A	TBD *(d)*	TBD *(d)*
East Chestnut Ridge Waste Pile	Sep-1987	—	—	—	—	—	x	TBD *(e)*	—
Kerr Hollow Quarry	Jan-1986	—	—	—	—	—	N/A *(f)*	TBD *(f)*	N/A *(f)*

UEFPC = Upper East Fork Poplar Creek
GWQAP = Ground-Water Quality Assessment Plan
GWQAR = Ground-Water Quality Assessment Report
TBD = To be determined
N/A = Not Applicable
X = Completed

(a) = Extends into UEFPC Watershed
(b) = To be included in GWQAR for Bear Creek Watershed
(c) = To be included in GWQAR for UEFPC Watershed
(d) = Currently under negotiation.
(e) = Dependent upon detection monitoring results.
(f) = Site will be clean-closed; no monitoring required

Table 4-2. RCRA Solid Waste-Management Units at the Y-12 Plant

SWMU Name	SWMU Number	Status of RFI Plan				Media to be addressed		
		Scheduled	Submitted to EPA	Revised	Approved by EPA	Soil	Ground Water	Surface Water
Bear Creek Watershed								
Oil Retention Pond No. 1	T-008 *(a)*	—	—	—	—	—	—	—
Oil Retention Pond No. 2	T-009 *(a)*	—	—	—	—	—	—	—
Haz. Chem. Storage Area Boneyard/Burnyard	D-024-HC *(b)*	—	—	—	—	—	—	—
Sanitary Landfill I	D-102 *(b)*	—	—	—	—	—	—	—
Rust Spoil Area	D-106	—	1987	1989	—	X	X *(e)*	*(g)*
Spoil Area 1	D-107	—	1987	1989	—	X	X *(e)*	*(g)*
SY-200 Yard	S-123	—	1989	—	—	X	X *(e)*	*(g)*
UEFPC Watershed								
S-2 Site	D-103 *(c)*	—	1987	1989	—	X	X *(f)*	*(h)*
Coal Pile Trench	D-104	TBD	—	—	—	—	—	—
9418 Uranium Vault	D-115	—	1987	—	—	X	X *(f)*	*(h)*
Bldg 9409-5 Storage Facility	S-017	TBD	—	—	—	—	—	—
Salvage Yard Oil Storage Area	S-018 *(c)*	—	1987	1989	—	X	X *(f)*	*(h)*
Salvage Yard Oil/Solvent Drum Storage	S-020 *(c)*	—	1987	1989	—	X	X *(f)*	*(h)*
Interim Drum Yard	S-030 *(c)*	TBD *(d)*	—	—	—	—	—	—
Salvage Yard Scrap Metal Storage Area	S-111 *(c)*	—	1987	—	—	X	X *(f)*	*(h)*
Bldg 81-10 Area	S-117	—	1988	—	—	X	X *(f)*	—
Line Yard (West of 9720-8)	S-120	—	1987	1989	—	X	—	—
Waste Z-Oil Tank (Bldg 9419-9)	S-121	—	1987	—	—	X	—	—
Dock 164 (Bldg 9808)	S-313	TBD	—	—	—	—	—	—
9201-1 West Yard	S-321	TBD	—	—	—	—	—	—
9401-2 Poly Tank Station	S-334	—	1988	—	—	X	—	—
9401-3 East Yard	S-335	TBD	—	—	—	—	—	—
Bldg 9712 Northeast Yard	S-338	TBD	—	—	—	—	—	—
9401-2 East Yard (Bldg 9720-29)	S-351	—	1988	—	—	X	—	—
Rust Construction Garage Area	S-400 *(c)*	TBD	—	—	—	—	—	—
Waste Coolant Processing Facility	T-038	—	1987	1989	—	X	X *(f)*	—
Salvage Yard Drum Deheader	T-109 *(c)*	—	1987	1989	—	X	X *(f)*	*(h)*
Nitric Acid Pipeline	?	1989	—	—	—	X	X *(f)*	—
Tank 2064-U	S-205	—	1987	—	—	X	X *(f)*	—
Tank 2063-U	S-204 *(c)*	—	1987	1989	—	X	X *(f)*	—
Tank 2101-U	S-210	—	1988	—	—	X	X *(f)*	—
Tank 2104-U	S-212	—	1988	—	—	X	X *(f)*	—
Tank 2105-U	S-213	TBD	—	—	—	—	—	—
Tank 2116-U	S-214	—	1988	—	—	X	X *(f)*	—
Bldg 9204-4 Tank (1)	S-215	TBD	—	—	—	—	—	—
Bldg 9204-4 Tank (2)	S-217	—	1988	—	—	X	X *(f)*	—
Bldg 9204-4 Tank (3)	S-218	—	1988	—	—	X	X *(f)*	—
Tank	S-225	TBD *(d)*	—	—	—	—	—	—
Bldg 9206 Tank (1)	S-227	TBD	—	—	—	—	—	—
Bldg 9206 Tank (2)	S-228	TBD	—	—	—	—	—	—
Chestnut Ridge								
Sanitary Landfill II	D-192	TBD	—	—	—	—	—	—
Filled Coal Ash Pond	D-112	—	1988	—	—	—	X	X
Temporary Storage Area	S-126	TBD	—	—	—			
Tank 2069-U	S-206	TBD	—	—	—	—	—	—
Tank 2070-U	S-207	TBD	—	—	—	—	—	—
Tank 2071-U	S-208	TBD	—	—	—	—	—	—

TBD - To Be Determined.
(a) Included in RCRA closure and investigation at the Bear Creek Burial Grounds
(b) Included in RCRA closure and investigation at the Oil Landfarm
(c) Included in S-3 Site Waste Management Area
(d) Tentative; final determination will be made at closure.
(e) Ground water investigation included in contamination assessment program for Bear Creek watershed
(f) Ground water investigation included in contamination assessment program for UEFPC watershed
(g) To be addresed under RFI for Bear Creek
(h) To be addresed under RFI for EFPC

4.3.4 CERCLA Sites

In May 1985, DOE issued Order 5480.14 defining how CERCLA was to be implemented at all DOE installations, with the exception of those facilities designated for remedial action under the Formerly Utilized Sites Remedial Action Project, the Uranium Mill Tailings Remedial Action Project, the Grand Junction Remedial Action Project, and the Surplus Facilities Management Program (H&R Technical Associates, Inc., 1988). A preliminary listing of all the sites at the Y-12 Plant which were subject to the DOE CERCLA program was prepared in 1986 but since that time, a number of those sites have been reclassified as SWMUs and releases from these sites will be addressed under RCRA section 3004(u) (H&R Technical Associates, Inc., 1988). Sites still currently regulated under DOE CERCLA are listed on Table 4-3. The locations of the DOE CERCLA sites at the Y-12 Plant are illustrated in Figure 4-10 (in pocket).

In July 1989 the USEPA proposed that the entire Oak Ridge Reservation be placed on the National Priorities List (NPL). The impact of this listing has not been defined at this time; however, it is conceivable that corrective actions deemed appropriate for the RCRA sites at the Y-12 Plant may be subject to review under the auspices of the federal CERCLA program. The monitoring programs described herein have been designed in the context of this conservative assumption. However, the FFA currently being negotiated should serve to clarify this issue.

4.4 NONHAZARDOUS WASTE SITES

In June 1988, the TDHE issued draft regulations designed to govern all nonhazardous solid waste-management practices in the State of Tennessee (Tennessee Department of Health and Environment, 1988). These regulations will establish six types of non-hazardous solid-waste disposal facilities (SWDF); sanitary municipal landfills (Class I facilities), industrial landfills (Class II facilities), landfills for farming wastes or woody refuse (Class III facilities), landfills for construction, demolition, and other inert wastes (Class IV facilities), land farming facilities (Class V facilities), and surface impoundments used for disposal of non-hazardous wastes (Class VI facilities). Each type of the above listed facilities would be required to have a permit issued by the TDHE except: (1) Class III facilities less than 1 acre in size and located at the site of waste-generation, and (2) Class IV facilities less than 1 acre in size.

4.5 UNDERGROUND STORAGE TANKS

The HSWA established under a new Subtitle I to the RCRA regulations a comprehensive regulatory program for underground storage tanks (USTs). The Subtitle I regulations, contained in 40 CFR Part 280, generally pertain to all USTs used to store "regulated substances." Regulated substances are defined as hazardous substances listed under the CERCLA regulations (40 CFR Part 302) and liquid petroleum products. However, RCRA regulated wastes are specifically exempt from the Subtitle I (UST) regulations; releases from USTs which contain RCRA wastes are addressed under the regulations governing SWMUs. A list of the USTs at the Y-12 Plant subject to regulation under 40 CFR Part 280 is provided on Table 4-4. The locations of these tanks are illustrated in Figure 4-11 (in pocket).

Table 4-3. DOE CERCLA Sites at the Oak Ridge Y-12 Plant

Site Name	DOE Order 5480.14 CERCLA Program					
	Preliminary Assessment	Phase I	Phase II	Phase III	Phase IV	Phase V
9401-1 Old Steam Plant	X	X	X	—	—	—
9720-2 Drum Storage Area	X	X	X	—	—	—
Old Mercury Storage Area	X	—	—	—	—	—
Bldg 9204-3	X	—	—	—	—	—
Bldg 9404-3	X	X	X	—	—	—
Bldg 9404-6	X	—	—	—	—	—
Bldg 9409-15	X	—	—	—	—	—
Bldg 9418-1	X	—	—	—	—	—
Bldg 9620-2/Z Oil Filter House	X	X	X	—	—	—
Bldg 9731-2	X	—	—	—	—	—
Tank 1067 (East of bldg 9620-2)	X	X	X	—	—	—
Tank 302 (South of Bldg 9620-2)	X	X	X	—	—	—
Tank 304 (Bldg 9418-4)	X	X	X	—	—	—
Tank 305 (Bldg 9418-5)	X	X	X	—	—	—
Tank 306 (Bldg 9418-6)	X	X	X	—	—	—
Tank 315 (Bldg 9409-3)	X	X	X	—	—	—
Tank B3-304 Bldg 9204-3	X	—	—	—	—	—
Tank B3-338 Bldg 9204-3	X	—	—	—	—	—
Tank B3-339 Bldg 9204-3	X	—	—	—	—	—
Tank Be-305 Bldg 9204-3	X	—	—	—	—	—
Tank X-300 (North of Bldg 9731)	X	—	—	—	—	—
Tank X-301 (North of Bldg 9731)	X	—	—	—	—	—

Table compiled from:

1. "Y-12 Plant Environmental Remedial Action Projects", (Map), prepared by KCA Engineering, October 3, 1988, (C2F-XXXXX-SK).

2. "CERCLA Phase II Report, Characterization of Inactive Hazardous Waste Disposal Sites, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Prepared by H&R Technical Associates, January 1988 (H&R 260-10)(Draft).

Program Components:

Phase I - Installation Assessment
Phase II - Site Characterization
Phase III - Engineering Assessment
Phase IV - Remedial Action
Phase V - Compliance and Verification

X = Phase Completed

Table 4-4. Non-SWMU Underground Storage Tanks at the Y-12 Plant

Tank Identification Number	Installation Date	Out of Service Date	Capacity (Gallons)	Contents	Status	Release/Detection Investigation Results/Schedule	Preliminary Investigation	Release Characterization (Date of EAP or SIP)	Corrective Action
Bear Creek Watershed									
2316-U	1986	In Use	550	Diesel	To be upgraded	Dec-93	N/A	TBD	TBD
UEFPC Watershed									
0134-U	1966	1982	120	Gasoline	Removed 8/88	Confirmed Release	Completed	Jan-90	TBD
0439-U	1978	1989	20,000	Gasoline	Removed 9/89	Confirmed Release	Completed	Oct-89	TBD
0440-U	1978	1989	10,000	Diesel Fuel	Removed 9/89	Confirmed Release	Completed	See 0439-U	See 0439-U
0713-U	1955	1989	10,500	No. 2 Fuel Oil	Removed 11/88	Resample 1990	Completed	TBD	TBD
0928-U	1968	1989	200	Gasoline	Removed 5/89	No Release	N/A	N/A	TBD
1219-U	1946	1988	12,000	Diesel Fuel	Removed 12/89	Confirmed Release	Completed	Dec-87, Aug-88	TBD
1222-U	1968	1988	12,000	Gasoline	Removed 12/89	No Release	N/A	See 1219-U	See 1219-U
2068-U	1968	1980	1,000	Gasoline	Removed 2/90	Sample 2/90	In Progress	See 1219-U	See 1219-U
2073-U	1963	1979	1,000	Gasoline	To be removed	TBD	TBD	See 0439-U	See 0439-U
2074-U	1963	1979	1,000	Gasoline	To be removed	TBD	TBD	See 0439-U	See 0439-U
2075-U	1963	1979	1,000	Fuel Oil	To be removed	TBD	TBD	See 0439-U	See 0439-U
2077-U	1953	1964	65	Gasoline	Removed 1964	NI	TBD	TBD	TBD
2078-U	1965	1979	110	Gasoline	Inert Filled 1979	NI	TBD	TBD	TBD
2079-U	1965	1979	55	Gasoline	Inert Filled 1979	NI	TBD	TBD	TBD
2080-U	1971	1987	560	Gasoline	Removed 11/88	No Release	N/A	N/A	N/A
2081-U	1958	1970	280	Gasoline	To be removed.	Sample 4/90	TBD	TBD	TBD
2082-U	1981	1988	8,000	Gasoline	Removed 12/89	Confirmed Release	Completed	See 1219-U	See 1219-U
2099-U	1971	1989	560	Gasoline	Removed 7/89	No Release	N/A	N/A	N/A
2117-U	1971	1983	550	No. 2 Fuel Oil	Removed 10/88	Reseample 1990	TBD	TBD	TBD
2130-U	1960	In Use	580	Gasoline	To be removed	No Release	N/A	N/A	N/A
2293-U	1954	1975	58	Gasoline	Removed 1975	NI	TBD	TBD	TBD
2294-U	1954	1975	58	Gasoline	Removed 1975	NI	TBD	TBD	TBD
2305-U	1956	In Use	55	Gasoline	To be removed	No Release	N/A	N/A	N/A
2310-U	1964	1989	200	Gasoline	Removed 11/89	Release	Jan-90	Jan-90	TBD
2313-U	1986	In Use	550	Diesel	To be upgraded	Dec-93	N/A	N/A	N/A
2315-U	?	1989	65	Gasoline	Removed 11/89	Resample 1990	TBD	TBD	TBD
2320-U	1988	In Use	550	Diesel	To be upgraded	Dec-93	N/A	N/A	N/A
2330-1	1949	1988	5,000	Diesel	Inert Filled 1988	NI	TBD	TBD	TBD
Chestnut Ridge									
2312-U	1986	In Use	550	Diesel	To be upgraded	Dec-93	N/A	N/A	N/A

NOTE: NI = Not Investigated
? = Information not available
TBD = To be determined
EAP = Environmental Assessment Plan
SIP= Site Investigation Plan

5. Y-12 GWPP ORGANIZATION, ROLES, AND RESPONSIBILITIES

The organization roles and responsibilities of the various portions of the Y-12 GWPP are presented in this section. A subsequent section will summarize the plans that are used to implement the organization discussed in this section.

5.1 ORGANIZATION

Responsibility for the Y-12 GWPP lies with the GWPP Manager, who is a member of the Environmental Management Department (EMD) within the Health, Safety, Environment, and Accountability (HSEA) Division of the Y-12 Plant. Figure 5-1 shows the line organization from Plant Manager to GWPP Manager.

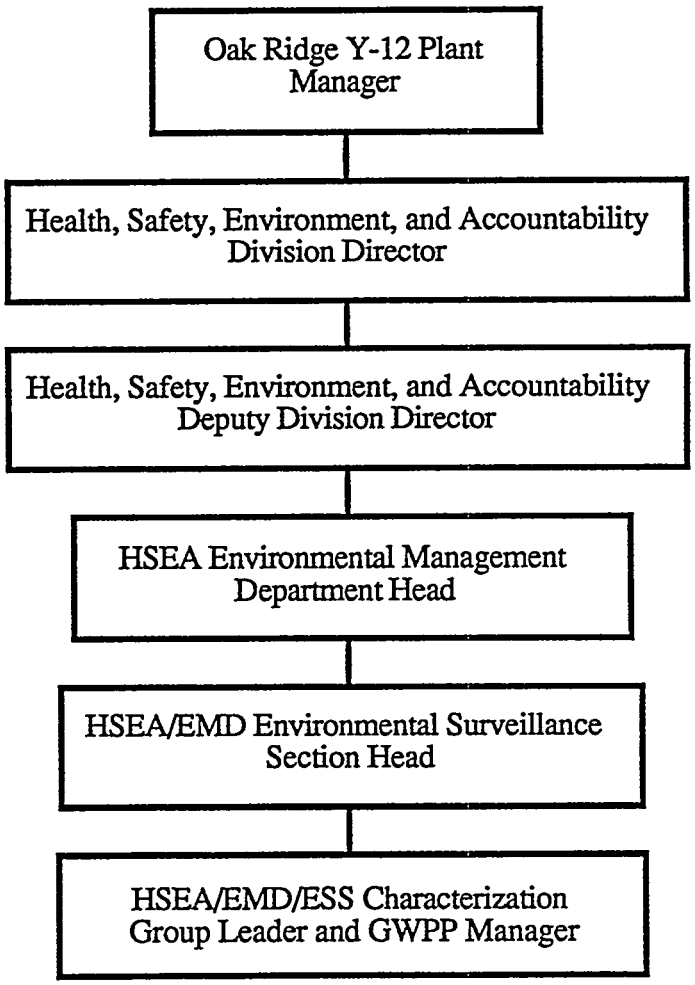

Fig. 5-1. Line organization of the Health, Safety, Environment, and Accountability Division at the Oak Ridge Y-12 Plant.

The Y-12 GWPP is a multielement, multidisciplinary, matrix organization with the GWPP Manager acting as the central coordinator and primary interface with other programs. Each element of the program has specified functions which are implemented by the designated elemental project manager/supervisor. Figure 5.2 depicts the matrix organization of the Y-12 GWPP. The following subsections broadly define the major roles and responsibilities of each element of the GWPP.

5.2 PROGRAM MANAGEMENT

Management of the Y-12 GWPP is the responsibility of the Environmental Surveillance Section of the Environmental Management Department within the HSEA Division. Within the GWPP two positions, the Program Manager and the Project Manager, have primary responsibility for implementation of the GWPP.

5.2.1 GWPP Manager

The GWPP Manager is the Characterization Group Leader within the Environmental Surveillance Section (ESS). Primary responsibility of the GWPP Manager include: (1) preparation of the GWPP Management Plan to reflect the needs of the Y-12 GWPP and other programs it serves, (2) implementation of the GWPP Management Plan through coordination of the GWPP matrix organization, and (3) obtaining and allocating sufficient funds to ensure the execution of the development and implementation of the GWPP Management Plan.

The GWPP Manager serves as the contact between the Y-12 GWPP matrix organization and DOE, regulatory agencies (through DOE), Environmental and Safety Activities (E&SA) Organization, and other Energy Systems programs. The GWPP Manager is responsible for maintaining the quality of the GWPP and is ultimately responsible for the success of the program as a whole and each of the individual elements. The GWPP Manager is also responsible for generating all annual groundwater quality assessment plans and reports to meet regulatory and programmatic requirements within policies and guidelines established by Energy Systems and DOE.

5.2.2 GWPP Project Manager

The GWPP Project Manager is the Groundwater Characterization Supervisor within the Characterization Group of the Environmental Surveillance Section. The GWPP Project Manager reports to the GWPP Manager and has primary responsibility to (1) implement GWPP plans, (2) review hydrogeologic assessments and recommendations, (3) review well installation specifications, (4) initiate and supervise drilling and well installation programs, (5) coordinate well maintenance program, and (6) ensure that groundwater monitoring wells are installed according to specifications.

5.3 HEALTH AND SAFETY

Health and safety is the responsibility of each task project manager with support from the Industrial Hygiene and Health Physics Departments within the HSEA Division of the Y-12 Plant. Individual health and safety plans exist or are being developed for specific tasks within the Y-12 GWPP (Section 6.1).

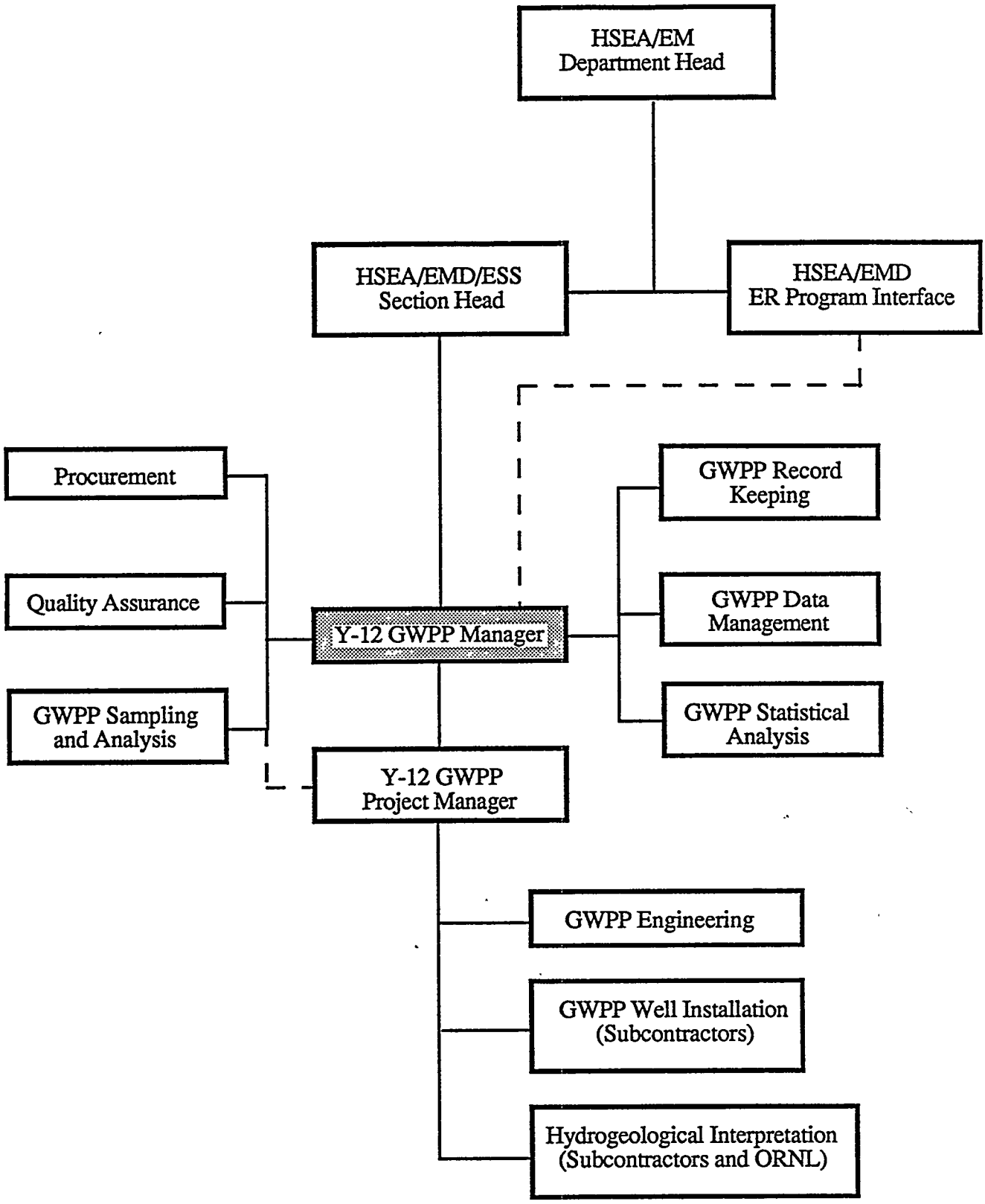

Fig. 5-2. Organization of the Oak Ridge Y-12 Plant GWPP

5.4 QUALITY ASSURANCE

Quality assurance for the Y-12 GWPP is the responsibility of the Environmental Management Department Quality Assurance (QA) Coordinator. Primary responsibilities of the QA Coordinator are to: (1) aid in the preparation and implementation of Quality Assurance Plans (Section 6.2), (2) provide the GWPP Manager or elemental project managers with assistance in meeting a programmatic or elemental quality objective, (3) develop an audit tracking system to monitor progress in addressing program deficiencies which have been identified internally or externally, and (4) provide assistance with quality reviews of programs, projects, or documents.

5.5 PROCUREMENT

Procurement of the necessary subcontract drilling, well installation, and geotechnical support services for the Y-12 GWPP are handled by the Energy Systems Engineering Division. The Engineering Division assumes responsibility to (1) consult with the GWPP Manager and the GWPP Project Manager to obtain technical and operational requirements and specifications, (2) prepare documents to obtain subcontractor services, (3) work with Martin Marietta Energy Systems Procurement Division to procure subcontractor services, and (4) provide assistance for subcontract maintenance. Procurement of other services and materials for the Y-12 GWPP are handled by direct interaction with appropriate GWPP elemental managers and the Energy Systems Procurement Division with support from the HSEA Finance Officer. All procurements for the Y-12 GWPP are conducted following established governmental and Energy Systems procedures and practices.

5.6 ENGINEERING AND WELL INSTALLATION

Engineering services for the Y-12 GWPP are coordinated through the Project Engineer (PJ), who is a member of the Energy Systems Engineering Division. Primary responsibilities of the PJ are (1) upon request from the GWPP Project Manager, establish of Engineering Service Orders and Work Releases for subcontractor services and engineering support for drilling services and well installations, (2) track subcontractor costs, and (3) approve subcontractor invoices for payment. The Construction Engineer (CE) has responsibilities to (1) acquire necessary permits for drilling and well installations, such as excavation, welding, and work safety permits, (2) coordinate on-site supervision of drilling and well installation subcontractors, and (3) supply of health and safety equipment to drilling services and geotechnical services subcontractors.

5.7 SAMPLING AND ANALYSIS

Sampling and analysis of groundwater for the Y-12 GWPP are coordinated through the GWPP Manager and are the responsibility of both the GWPP Manager and Analytical Project Manager. Primary responsibilities of the GWPP Manager include: (1) assistance in preparation of the Sampling and Analysis Plan, (2) implementation of the Sampling and Analysis Plan, (3) assurance that established sampling procedures are followed, and (4) development of annual sampling schedules to be included in the Groundwater Monitoring Plan. Primary responsibilities of the Analytical Project Manager include: (1) preparation and implementation of the Sampling and Analysis Plan, (2) assurance that established analytical procedures are followed, and (3) consultation with analytical personnel in development and incorporation of new analytical procedures. The Analytical Project Manager reports to the GWPP Manager and coordinates analytical activities with the Sampling Coordinator. The Analytical Project Manager, who is a member of the ORGDP

Analytical Chemistry Division, coordinates all laboratory activities for the Y-12 Plant GWPP. Details of the Sampling and Analysis Plan are summarized in Section 6.5.

5.8 DATA MANAGEMENT

Management of the groundwater database is the responsibility of the Y-12 GWPP Database Manager. This position is currently filled by a database professional from H & R Technical Associates, under subcontract to Energy Systems. The Database Manager reports to the GWPP Manager. Primary responsibilities of the Database Manager are to (1) design, update, and maintain a Statistical Analysis System (SAS) database for data collected and analyzed during implementation of the Y-12 Groundwater Monitoring Program, (2) assist in the design, implementation, update, and maintenance of the Y-12 Data Management Plan, (3) assist in the design, implementation, update, and maintenance of the Y-12 Groundwater Monitoring Program, (4) track the sampling and data transfer activities relative to the schedules established in the Y-12 Groundwater Monitoring Program, (5) implement data verification and evaluation to ensure data quality objectives established in the Groundwater Monitoring Program, (6) establish and implement procedures for database security and backup, (7) respond to hard copy and electronic data transfer requests made to and approved by the GWPP Manager, and (8) prepare regulatory and statistical reports and any other data summaries as requested by the GWPP Manager. The Data Management Plan is discussed in Section 6.6.

5.9 STATISTICAL ANALYSIS

Statistical analysis of groundwater data is the responsibility of the Y-12 GWPP Database Manager, who reports to the GWPP Manager. The Database Manager position is currently filled by a database professional from H & R Technical Associates, under subcontract to Martin Marietta Energy Systems, Inc. The Database Manager coordinates statistical analysis activities with the GWPP Manager and personnel responsible for hydrogeological interpretation (see Section 5.11). Primary responsibilities of the Database Manager in the area of statistical analysis include (1) perform statistical t-tests required by RCRA for the waste disposal sites included in the Groundwater Monitoring Program (2) generate summary statistics by site for the annual Environmental Surveillance Report - Oak Ridge, (3) generate summary statistics and graphical presentations in response to requests made or approved by the GWPP manager, and (4) assure the quality of the statistical analyses performed. A statistical analysis plan is included in the Y-12 Data Management Plan (Section 6.6).

5.10 RECORD KEEPING AND DOCUMENT CONTROL

Record keeping and document control for the Y-12 GWPP are the ultimate responsibility of the GWPP Manager. These responsibilities include (1) generation and archiving of reports and documents to meet regulatory requirements, (2) acquisition of appropriate reference and guidance documents and materials, (3) development and maintenance of an audit tracking system for key regulatory audit information, and (4) preparation of the Y-12 GWPP Bibliography (see Appendix B) and guidance document listing (Section 2.4). Individual elements of the GWPP are responsible for documenting and reporting activities related to the program. Control and tracking of these records and documents are included in the individual activity plans (Section 6), and coordination of the record keeping and documentation is the responsibility of the GWPP Manager.

5.11 HYDROGEOLOGICAL INTERPRETATION

Hydrogeological interpretation of groundwater data and statistical results are the responsibility of the GWPP Project Manager. Assisting the Project Manager with hydrogeological interpretation are a hydrogeological subcontractor (Geraghty and Miller) and hydrogeological consultants from the Oak Ridge National Laboratory. Primary responsibility of the Project Manager for hydrogeological interpretations are: (1) compilation of the Groundwater Quality Assessment Plans for interim status sites in assessment monitoring, (2) preparation and implementation of the Well Installation Plan, Well Plugging and Abandonment Plan, and the Groundwater Monitoring Plan, (3) preparation of technical reports and correspondence, (4) serving as technical consultant to other programs, (5) preparation and implementation of a Well Inspection and Maintenance Plan, (6) identification of needs for subcontractor services, and (8) serving as technical contact for subcontracts. Details of the Well Installation Plan, the Groundwater Monitoring Plan, Well Plugging and Abandonment Plan, and the Well Inspection and Maintenance Plan are included in Sections 6.3, 6.4, 6.9, and 6.10 respectively.

5.12 ENVIRONMENTAL RESTORATION PROGRAM

The two principal areas of activity for the Y-12 Plant GWPP, environmental surveillance and environmental restoration, are the responsibility of different organizations within the Y-12 Plant. Environmental monitoring, surveillance activities, and initial characterization and evaluation for groundwater are conducted by the Environmental Surveillance Section of the Y-12 Environmental Management Department. All corrective measures and remedial actions, including those pertaining to groundwater, at the Y-12 Plant are conducted by the ERP, which is an Energy Systems organization. The Environmental Impacts and Restoration Section Head in the Y-12 Environmental Management Department coordinates groundwater related activities between the Y-12 GWPP and the Energy Systems ERP. After a site has gone through initial evaluation and characterization, which typically includes interim status groundwater monitoring, the site is passed from the Environmental Surveillance Section to the Environmental Impacts and Restoration Group for incorporation in the Energy Systems ERP. Corrective and remedial action plans are prepared for each site that has been incorporated into the ERP. The ERP will work directly with the Environmental Surveillance Section to implement the GWPP throughout the remediation process.

6. PROJECT PLANS

This section provides a summary of the various project plans that have been developed or are under development to guide the execution of all aspects of the Y-12 GWPP. The actual plans are contained in the references cited within the text.

6.1 HEALTH AND SAFETY PLANS

A comprehensive Health and Safety Plan for environmental programs and related activities at the Y-12 Plant is under development. Several specific activities of the GWPP have Health and Safety Plans in effect. In particular all field operations, including drilling and well installation, are conducted in accordance with an approved plan (EDGe Group, 1989b) that ensures that all health and safety requirements of 29 CFR 1910.120 are satisfied. The field operations health and safety plan: (1) summaries general health and safety information and policies, (2) identifies responsibilities for key personnel, such as the site health and safety officer, construction engineer, and hydrogeologist, (3) outlines personal protective clothing requirements, (4) outlines first aid and medical screening procedures, (5) summarizes potential health and safety hazards, and (6) specifies procedures and safe work practices that are to be followed.

6.2 QUALITY ASSURANCE PLAN

A comprehensive Quality Assurance Plan (QAP) for the Environmental Monitoring Section of the Y-12 HSEA Division is under development (Environmental Management Department, 1990). The plan identifies key personnel responsible for implementation of the QAP and provides for the planning and accomplishment of activities affecting quality assurance. Specifically, the plan addresses procurement procedures, document control, sample identification and control, qualification requirements for analytical and sampling techniques, equipment calibration requirements, corrective actions, quality assurance records and audits. A separate QAP for RCRA Facility Investigations (RFIs) is in effect (Wiggins 1988) that addresses similar issues. Although the GWPP Manager is ultimately responsible for the implementation of the QAP and for assuring and verifying the quality of the GWPP, each elemental or project manager is responsible for the day-to-day implementation of the QAP. In addition to the GWPP Manager, implementation of the QAP is supported by a QA Coordinator.

To supplement existing QAPs, environmental surveillance procedures have been developed (Kimbrough, Long, and McMahon, 1988). This manual represents a consolidated source of requirements, instructions, and information concerning environmental data gathering, sampling, and analysis. Included is a description of each activity, its scope and application, references, a summary of methods, pertinent comments, a list of required equipment and supplies, safety requirements and considerations, procedures, contamination control, and QA/QC requirements.

6.3 GROUNDWATER MONITORING WELL INSTALLATION PLAN

A Groundwater Monitoring Well Installation Plan will be developed for each fiscal year. The plan will include the number and locations of monitoring wells to be installed at each site, completion zones and construction specifications for each well or type of well, a schedule for installation, and documentation requirements for well installations and

development. Site descriptions and hydrogeology and the rationale for well installations are provided in programmatic plans which form the basis of the Groundwater Monitoring Plan (Section 6.4). Modifications to the Well Installation Plan will be issued as addenda and will include the reason for the modification, the site(s) and well(s) affected, special procedures to be utilized, and the date of the revision. Well specifications and the procedures and equipment needed to construct, install, and develop groundwater monitoring wells are contained in Geraghty and Miller, Inc. (1985d). Environmental surveillance procedures relating to well installation are contained in Kimbrough, Long, and McMahon (1988). To supplement the Well Installation Plan, procedures for the disposal of drill cuttings and fluids and well development water will be developed that are consistent with Energy Systems and DOE policies.

The GWPP Project Manager is responsible for generating and implementing the Well Installation Plan and ensuring that it meets regulatory and programmatic needs. Additionally, the GWPP Project Manager is responsible for obtaining adequate funding for the implementation of the Well Installation Plan through coordination with the GWPP Manager. Upon request from the GWPP Project Manager, the Project Engineer initiates engineering service orders and work releases to obtain subcontractor services and engineering support (Construction Engineer) for well installations and geotechnical oversite. Engineering service orders are approved by the Energy Systems Procurement Division and the HSEA Finance Officer. The Construction Engineer: (1) acquires the necessary permits for drilling and well installations, such as excavation, welding, and work safety permits, (2) coordinates on-site supervision of drilling and well installation subcontractors through the geotechnical subcontractor, (3) ensures that the subcontractor complies with Energy Systems policies and procedures concerning health and safety, and (3) supplies health and safety equipment to drilling and geotechnical services subcontractors. The geotechnical subcontractor (a registered professional geologist in the State of Tennessee) ensures that the drilling subcontractor complies with technical specifications and procedures for well installations and documents all well construction and development information. The geotechnical subcontractor also provides health and safety monitoring at the site.

6.4 GROUNDWATER MONITORING PLAN

The Groundwater Monitoring Plan is maintained by the GWPP Manager. The plan is a breakdown of the monitoring program by site or subsite, and identifies wells to be sampled, sampling schedule and frequency, the order in which wells are to be sampled, chemical parameters of interest, and a reporting schedule. The plan is reviewed and updated throughout the current year. As new monitoring wells are completed they are added to the plan, and as old wells are plugged and abandoned, they are removed from the plan.

The responsibility for developing the Groundwater Monitoring Plan rests with the GWPP Manager, who integrates monitoring requirements from five programs into the Groundwater Monitoring Plan. Monitoring requirements for interim status sites are contained in the Groundwater Quality Assessment Reports (GWQARs) which are prepared by the GWPP hydrogeological consulting subcontractors. The GWQARs contain rationale and justification for additional well installations and sampling recommendations at each interim status site. RCRA Facility Investigation (RFI) plans identity groundwater monitoring needs at solid waste management units (SWMUs). Once monitoring wells identified in the RFI plan for a site have been installed, they are added to the Groundwater Monitoring Plan. RCRA Post-Closure Permit applications specify groundwater monitoring requirements at sites that have been granted post-closure status. As post-closure permits

are granted, groundwater monitoring wells installed to satisfy permit requirements are added to the Groundwater Monitoring Plan. Underground Storage Tank (UST) site investigation plans identify groundwater monitoring needs at UST sites. Monitoring wells installed at UST sites are added to the monitoring plan as they are completed. The Comprehensive Groundwater Monitoring Plan for the Y-12 Plant (Geraghty & Miller 1990) identifies groundwater monitoring requirements to characterize plume migration in the three watersheds affected by Y-12 Plant operations. As wells are installed according to the comprehensive plan, they will be added to the Groundwater Monitoring Plan.

6.5 SAMPLING AND ANALYSIS PLAN

A sampling and analysis plan for groundwater monitoring activities at the Y-12 Plant was issued in January, 1990 (Burnett and Dill, 1990). The sampling and analysis plan describes techniques and systems necessary to obtaining reliable characterization data from groundwater wells and to ensure uniform results. The plan provides a standard for all activities involved in collecting and analyzing samples, and in reporting data. Specifically, it contains procedures that are to be followed for sample collection, sample preservation and handling, chain of custody, sample analysis, quality control/quality assurance, and data quality evaluation.

The GWPP Analytical Project Manager is responsible for the actual implementation of the Sampling and Analysis Plan. He/she coordinates and schedules sampling (with the Sampling Coordinator) and analysis of all groundwater wells specified in the Groundwater Monitoring Plan (Section 6.4). He/she ensures that the proper analytical methods are utilized and that QC protocols are followed. He/she ensures that analyses are conducted in a timely manner so that results for a site are available for electronic transfer to the GWPP Database Manager, according to the data transfer schedule. He/she provides the Y-12 GWPP Manager with weekly status reports that consist of the sampling sheets received during the reporting period, a listing of any well maintenance problems and access problems encountered during sampling, an update of the sampling schedule, and any QA/QC problems encountered and the current laboratory status of samples. The Analytical Project Manager is responsible for the quality of the data prior to its electronic release to the Database Manager. He/she provides hard copies of electronically transferred data to the Database Manager, the GWPP Manager, and to the hydrogeological consulting subcontractor. The Analytical Project Manager archives all data, both electronically and on hard copy. He/she reviews the field QC data and notes deficiencies in the weekly status report. He/she provides timely notification of any data errors, omissions, or quality failures to the GWPP Manager. Finally, the Analytical Project Manager tracks analytical costs, notifies the GWPP Manager of any potential cost increases or potential overruns, and provides a quarterly report of the analytical costs on a per site basis.

The GWPP Sampling Coordinator is responsible for the actual sampling of groundwater monitoring wells in accordance with the Sampling and Analysis Plan and the Groundwater Monitoring Plan. He/she coordinates and schedules sampling events to correspond as closely as possible with the target schedule and provides timely notification of schedule deviations to the Analytical Project Manager and the GWPP Manager. He/she ensures: (1) that the samples are obtained by precisely following approved field procedures and QC protocols; (2) the quality of field-generated data (i.e., water level, pH, conductivity, temperature); (3) that the samples are properly labeled, handled, and delivered to the laboratory sample custodian following approved chain-of-custody protocols; and (4) that samples requiring specified radiochemical and asbestos parameters are delivered to the Oak Ridge National Laboratory Analytical Chemistry Department for analysis. The Sampling Coordinator implements corrective actions resulting from field QA deficiencies. Finally,

the Sampling Coordinator maintains well sampling histories and provides timely notification of any unusual circumstances (e.g., dry well conditions, extraordinarily high or low water levels, vapors or odors noted, discolored water, well damage, missing locks or caps, evidence of tampering, etc.) to the Analytical Project Manager, who in turn notifies the GWPP Manager.

6.6 DATA MANAGEMENT PLAN

A Data Management Plan has been developed by the Y-12 GWPP Database Manager, currently a database professional from H & R Technical Associates, under contract to Energy Systems. The plan incorporates three documents:

(1) A Tracking System for Sampling and Data Transfer Schedules (Mercier, 1990a).

(2) Initial Data Screening and Verification and Data Input into the Y-12 Groundwater Monitoring Program SAS Database (Westlund, 1990).

(3) Data Evaluation Procedures for Groundwater Monitoring Data (Mercier, 1990b).

Implementation of the Data Management Plan is the responsibility of the Database Manager with support from the Analytical Project Manager. Data are tracked between the Analytical Project Manager and the Database Manager utilizing project manager software in conjunction with tracking reports issued by the Database Manager. Analytical data are transferred electronically upon completion of analyses of samples from a site or subsite. Weekly summary reports and field sampling sheets are sent from the Analytical Project Manager to the GWPP Manager. Hard copies of data are sent to the Database Manager, GWPP Manager, and the hydrogeological consulting subcontractor on a quarterly basis. The Data Management Plan is modified as required and changes are documented by the Database Manager.

6.7 REMEDIAL/CORRECTIVE ACTION PLANS

All corrective measures and remedial actions, including those pertaining to groundwater, at the Y-12 Plant are conducted by the ERP, which is an Energy Systems organization. The ERP Interface within the Environmental Impacts and Restoration Section of the Y-12 Environmental Management Department coordinates groundwater related activities between the Y-12 GWPP and the Energy Systems ERP.

Groundwater remedial and corrective actions are addressed in Closure Plans developed for RCRA sites that have been granted interim status. Closure plans have been developed for eight sites at the Y-12 Plant. The plans describe current site conditions, summarize hydrogeological conditions, identify potential migration pathways and receptors, summarize closure options, and outline closure procedures and activities to be followed at a particular site. Within each of the closure plans, site-specific groundwater monitoring requirements are presented and the impact of closure operations on groundwater at the site is evaluated. The Environmental Impacts and Restoration Section Head is responsible for communicating groundwater monitoring requirements of closure operations to the GWPP Manager. The manager is responsible for integration of these requirements into the current year Well Installation and the Sampling and Analysis plans.

6.8 PERMITS

Post-closure permit applications have been prepared for six sites at the Y-12 Plant. The post-closure permit application contains a facility description, a summary of site hydrogeology and groundwater monitoring data, a description of groundwater contaminant plume(s), an outline of groundwater protection strategies to be followed at the site, a description of the compliance monitoring program, and a discussion of certification processes to be used at the site to ensure closure requirements are satisfied. The GWPP manager is responsible for integration of these requirements into the current year Well Installation and the Sampling and Analysis plans.

6.9 WELL PLUGGING AND ABANDONMENT PLAN

Well plugging and abandonment procedures to be followed for the decommissioning of damaged, unusable, or no-longer needed groundwater monitoring and investigation wells are outlined in Haase and Gillis (1989). Wells of similar construction materials and design are grouped together, and a single procedure was developed for each group of wells. The objective of each procedure is to prevent fluid migration into or between formations containing groundwater, to remove any casing that may have been in contact with contaminated material or groundwater, and to minimize the amount of waste materials generated during the plugging and abandonment procedure.

The GWPP Project Manager is responsible for generating an inventory of wells considered for plugging and abandonment, reviewing the plan annually, and issuing addenda as needed. The GWPP Project Manager designates wells to be plugged and abandoned through coordination with managers of other plant programs, review of well inspection and maintenance reports, and review of the annual Groundwater Monitoring Plan. Well inspection and maintenance reports identify wells that are damaged or unusable. Managers of other plant programs identify wells that must be removed because of construction or site closure activities. Wells no longer needed as part of a monitoring well network are identified during the development of the Groundwater Monitoring Plan. The GWPP Project Manger is also responsible for developing a schedule of plugging and abandonment activities, obtaining subcontractor services for the plugging and abandonment, obtaining engineering support for field operations oversite, and ensuring that the subcontractor complies with the plugging and abandonment procedures. An annual report documenting plugging and abandonment activities is issued.

6.10 WELL INSPECTION AND MAINTENANCE PLAN

The purpose of inspection and maintenance of monitoring wells is to extend the life of the well and to provide representative water levels and water quality samples. Development and implementation of the Well Inspection and Maintenance Plan is the responsibility of the GWPP Project Manager. The plan will include a list of wells requiring inspection, a checklist of items to be inspected (such as condition of concrete pads, hasps, caps, locks, and protective posts; the measured depth of the monitored interval compared to the constructed depth; and well access considerations), standardized forms for inspection and requests for maintenance, and a schedule for well inspections. The plan will also include procedures for inspection and reporting. As wells are inspected and problems requiring attention are identified, a schedule to repair or rehabilitate wells will be developed and updated throughout the year. Additionally, problems reported by sampling teams to the GWPP Manager will be added to the repair/rehabilitation schedule.

7. REFERENCES

Bechtel National, Inc., 1984a. "Interim Report on Bear Creek Valley Oil Landfarm Geology and Hydrogeology." Y/SUB/84-47974C/1.

Bechtel National, Inc., 1984b. "Geologic and hydrologic data for Bear Creek Valley Burial Grounds A and B." Y/SUB/84-47974C/2.

Bechtel National, Inc., 1984c. "The Geology and Hydrogeology of Bear Creek Valley Waste Disposal Areas A and B." Y/SUB/84-47974C/3.

Bechtel National, Inc., 1984d. "Interim Report on the Geology and Hydrogeology of the Southern and Western Perimeter to the Burial Grounds and the Interior Portions of Bear Creek Valley Waste Disposal Areas Environmental Field Studies." Y/SUB/84-47974C/4.

Burnett, L. P. and M. S. Dill, 1990. "Groundwater sampling and analysis plan for the K-25 and Y-12 sites." K/QT-167.

CH_2M Hill, 1988. "Ambient environmental monitoring program assessment, Oak Ridge Reservation, Oak Ridge, Tennessee." Report submitted to Martin Marietta Energy Systems, Inc., December 15, 1988.

EDGe Group, 1989a. "1988 Monitoring well installations at the Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-99005V/2.

EDGe Group, 1989b. "Health and safety plan for environmental field services at the Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-99005V/1.

Environmental Management Department, 1990. "Oak Ridge Y-12 Plant Environmental Monitoring Section quality assurance plan." In preparation.

Bechtel National, Inc., 1985. "Geologic data on twenty monitoring wells installed in Bear Creek Valley in September and October 1984." Y/SUB/84-477974C/12.

Geraghty and Miller, Inc., 1985a. "Remedial Alternatives for Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/3

Geraghty and Miller, Inc., 1985b. "Evaluation of monitoring well network in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/1.

Geraghty and Miller, Inc., 1985c. "Preliminary Findings of the 1984-85 investigations of contamination at the S-3 Ponds." Y/SUB/84-00206/3.

Geraghty and Miller, Inc., 1985d. "Guidelines for installation of monitor wells at the Y-12 Plant." Y/SUB/85-00206C/6.

Geraghty and Miller, Inc., 1986. "Phase IV Monitor-well drilling program in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/8.

Geraghty and Miller, Inc., 1987a. "Preliminary evaluation of hydrogeologic and water quality data from Phase IV wells located in Bear Creek Valley Waste Disposal Area for the Period Summer 1985 -September 1986." Y/SUB/87-00206C/9.

Geraghty and Miller, Inc., 1987b. "Proposed RCRA groundwater quality assessment plan for the S-3 Ponds Hazardous Waste Disposal Unit at the Y-12 Plant." Y/SUB/87-00206C/4.

Geraghty and Miller, Inc., 1987c. "Proposed RCRA groundwater quality assessment plan for the Oil Landfarm Hazardous Waste Disposal Unit at the Y-12 Plant." Y/SUB/87-00206C/6.

Geraghty and Miller, Inc., 1987d. "Proposed RCRA groundwater quality assessment plan for the Burial Grounds Hazardous Waste Disposal Unit at the Y-12 Plant." Y/SUB/88-00206C/3.

Geraghty and Miller, Inc., 1987e. "Groundwater quality assessment report in the S-3 Ponds Hazardous Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/1.

Geraghty and Miller, Inc., 1987f. "Groundwater quality assessment report in the Oil Landfarm Hazardous Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/2.

Geraghty and Miller, Inc., 1987g. "Groundwater quality assessment report in the Burial Grounds Hazardous Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/3.

Geraghty and Miller, Inc., 1987h. "Proposed RCRA Groundwater Quality Assessment Plan for New Hope Pond at the Y-12 Plant." Y/SUB/87-00206C/17.

Geraghty and Miller, Inc., 1987i. "Installation of monitor wells at the D-38 Pits and the Low Level Waste Disposal Development Demonstration Site at Oak Ridge Y-12 Plant." Y/SUB/87-00206C/14.

Geraghty and Miller, Inc., 1988a. "Groundwater quality assessment report in the S-3 Ponds Hazardous Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/88-00206C/1.

Geraghty and Miller, Inc., 1988b. "Groundwater quality assessment report in the Oil Landfarm Hazardous Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/88-00206C/2.

Geraghty and Miller, Inc., 1988c. "Groundwater quality assessment report in the Burial Grounds Hazardous Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/88-00206C/3.

Geraghty and Miller, Inc., 1988d. "Proposed RCRA Groundwater Quality Assessment Plan for the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit." Y/SUB/87-00206C/19.

Geraghty and Miller, Inc., 1989a. "Groundwater quality assessment report in the S-3 Ponds Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/7.

Geraghty and Miller, Inc., 1989b. "Groundwater quality assessment report in the Oil Landfarm Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/8.

Geraghty and Miller, Inc., 1989c. "Groundwater quality assessment report in the Bear Creek Burial Grounds Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/9.

Geraghty and Miller, Inc., 1989d. "Groundwater quality assessment report in New Hope Pond at the Y-12 Plant, 1988." Y/SUB/89-00206C/5.

Geraghty and Miller, Inc., 1989e. "Groundwater quality assessment report in the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/6.

Geraghty and Miller, Inc., 1989f. "Monitor well documentation report for the 1987 drilling program at the Oak Ridge Y-12 Plant." Y/SUB/89-00206C/20.

Geraghty and Miller, Inc., 1990. "Comprehensive groundwater monitoring plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/87-00206C/DRAFT.

H&R Technical Associates, Inc., 1988. "CERCLA Phase II report characterization of inactive hazardous waste disposal sites, U. S. DOE Y-12 Plant, Oak Ridge, Tennessee." H&R 260-10.

Haase, C. S., G. A. Gillis, and H. L. King, 1987a. "Fiscal Year 1985 groundwater investigation drilling program at the Y-12 Plant, Oak Ridge, Tennessee." ORNL/TM-9999.

Haase, C. S., H. L. King, and G. A. Gillis, 1987b. "Preliminary hydrological and hydrochemical assessment of the Beta-4 Security Pit, the Kerr Hollow Quarry, the Ravine Disposal , the Rogers Quarry, and the United Nuclear sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-272.

Haase, C. S., H. L. King, and G. A. Gillis, 1987c. "Preliminary hydrological and hydrochemical assessment of the Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-272.

Haase, C. S. and G. A. Gillis, 1989. "Plugging and abandonment procedures for the Oak Ridge Y-12 Plant." Y/TS-531.

Kimbrough, C. W., L. W. Long, L. W. McMahon, 1988. "Environmental surveillance procedures quality control program, Martin Marietta Energy Systems, Inc." ESH/Sub/87-21706/1.

King, H. L. and C. S. Haase, 1987. "Subsurface-controlled geological maps for the Oak Ridge Y-12 Plant and portions of Bear Creek Valley." ORNL/TM-10112.

King, H. L. and C. S. Haase, 1989. "Results and preliminary interpretation of hydrogeologic packer testing in core holes CH-157, GW-131, and GW-132 through GW-135 at the Oak Ridge Y-12 Plant." Y/TS-495.

King, H. L., D. L. Schaefer, and C. S. Haase, 1989. "Updated subsurface data base for Bear Creek Valley, Chestnut Ridge, and parts of Bethel Valley on the U. S. Department of Energy Oak Ridge Reservation." Y/SUB/89-E4371V/1.

King, H. L., C. S. Haase, and D. L. LaRue, 1989. "Groundwater investigation drilling program, Fiscal Years 1986, 1987, and 1988, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-E4371V/2.

Lee, R. R. and R. H. Ketelle, 1989. "Geology of the West Bear Creek Site." ORNL/TM-10887.

Lee Wan & Associates, Inc., 1989a (revised). "Post closure permit application for the New Hope Pond Site at the Y-12 Plant." Prepared for Martin Marietta Energy Systems (draft).

Lee Wan & Associates, Inc., 1989b (revised). "Post closure permit application for the Chestnut Ridge Sediment Disposal Basin at the Y-12 Plant." Y/TS-520.

Law Engineering, 1983. "Results of groundwater monitoring studies." Y/SUB/83-47936/1.

Martin Marietta Energy Systems, Inc., 1990. "Oak Ridge Reservation Environmental Report for 1990. Volume 1: Narrative, Summary, and Conclusions." ES/ESH-8/V1.

Mercier, T. M., 1990a. "A tracking system for sampling for sampling and data transfer schedules." IN Proceedings of the Conference on Data Analysis and Interpretation for Environmental Surveillance, February 5-7, 1990, Lexington, KY.

Mercier, T. M., 1990b. "Data evaluation procedures for groundwater monitoring data." IN Proceedings of the Conference on Data Analysis and Interpretation for Environmental Surveillance, February 5-7, 1990, Lexington, KY.

Pritz, P. M., 1983. "Master monitoring plan for groundwaters and surface waters. Oak Ridge Y-12 Plant." Unnumbered Martin Marietta Energy Systems, Inc. document.

Rothschild, E. R., R. R.Turner, S. H. Stow, M. A. Bogle, L. K. Hyder, O. M. Sealand, and H. J. Wyrick, 1984. "Investigation of Subsurface Mercury at the Oak Ridge Y-12 Plant." ORNL/TM-9092.

U. S. Environmental Protection Agency, 1985. "RCRA groundwater monitoring compliance order guidance." U. S. Environmental Protection Agency, Office of Waste Programs Enforcement, Washington, DC.

U. S. Environmental Protection Agency, 1986. "RCRA Facility Assessment guidance." U. S. Environmental Protection Agency, Waste Management Division, Office of Solid Waste, Washington, DC.

Westlund, E. S., 1990. "Initial data screening and verification and data input into the Y-12 Groundwater Monitoring Program SAS database." IN Proceedings of the Conference on Data Analysis and Interpretation for Environmental Surveillance, February 5-7, 1990, Lexington, KY.

APPENDIX

OAK RIDGE Y-12 PLANT GWPP BIBLIOGRAPHY

A.1 Y-12 PLANT GEOLOGY

A.1.1 GENERAL

Haase, C.S., E.C. Walls, and C.D. Farmer, 1985. "Stratigraphic Data for the Conasauga Group and the Rome Formation on the Copper Creek Fault Block Near Oak Ridge, Tennessee." ORNL/TM-9159.

Haase, C.S., G.A. Gillis, H.L. King, 1988. "Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy, Oak Ridge Reservation." ORNL/TM-10000.

Hasson, K.O. and C.S. Haase, 1988. Lithofacies and Paleogeography of the Conasauga Group (Middle and Late Cambrian) in the Valley and Ridge Province of East Tennessee." Geological Society of America Bulletin 100(2):234-246.

Hoos, A.B., and Z.C. Bailey, 1986. "Reconnaissance of Surficial Geology, Regolith Thickness, and Configuration of the Bedrock Surface in Bear Creek and Union Valleys, Near Oak Ridge, Tennessee." U.S. Geological Survey, Water-Resources Investigations Report. 86-4165.

Lee, R.R. and R.H. Ketelle, 1987. "Stratigraphic Influence on Deep Groundwater Flow in the Knox Group Copper Ridge Dolomite on the West Chestnut Ridge Site." ORNL/TM-10479.

McMaster, W. M., 1962. "Geologic Maps of the Oak Ridge Area, Tennessee. Prepared for the Research and Development Division, Oak Ridge Operations Office, U.S. Atomic Energy Commission." Printed by Army Map Service, U.S. Army Corp of Engineers.

McMaster, W.M., 1963. "Geologic Maps of the Oak Ridge Reservation, Tennessee: Oak Ridge National Laboratory, Health Physics Division." ORNL-TN-713.

Rodgers, J., 1953. "Geologic Map of East Tennessee with Explanatory Text." Tennessee Division of Geology Bulletin 58, Part II.

Roeder, D.H., O.E. Gilbert, and W.D. Witherspoon, 1978. "Evolution and Microscopic Structure of Valley and Ridge Thrust Faults, Tennessee and Virginia." University of Tennessee Studies in Geology, 2, The University of Tennessee, Knoxville, Tennessee.

U.S. Army Corps of Engineers, 1954. "Geologic Investigation - Alpha 5 Area, Y-12 Plant, Ohio River Division Lab.

A.1.2 BEAR CREEK VALLEY

Bechtel National, Inc., 1984. "Interim Report on Bear Creek Valley Oil Landfarm Geology and Hydrology." Y/SUB/84-47974C/1.

Bechtel National, Inc., 1984. "Geologic and Hydrogeologic Data for Bear Creek Valley Burial Grounds A and B." Prepared for Union Carbide Corporation, Nuclear Division, Y-12 Plant. Y/SUB/84-47974C/2.

Bechtel National, Inc., 1984. "The Geology and Hydrogeology of Bear Creek Valley Waste Disposal Areas A and B." Y/SUB/84/47974C/3.

Bechtel National, Inc., 1984. "Interim Report on the Geology and Hydrogeology of the Southern and Western Perimeter to the Burial Grounds and the Interior Portions of Bear Creek Valley Waste Disposal Areas Environmental Field Studies." Y/SUB/84-47974C/4.

Bechtel National, Inc., 1984. "Summary Report of Geologic Investigation Conducted During Phase III Well Installation Bear Creek Valley Waste Disposal Area." Prepared for Union Carbide Corporation, Nuclear Division.

Bechtel Civil and Minerals, Inc., 1984. "Report on Burial Grounds A and B, Geology and Hydrogeology, Environmental Field Studies, Bear Creek Waste Disposal Area." Prepared Union Carbide Corporation, Nuclear Division.

Geraghty & Miller, Inc., 1985. "Remedial Alternatives for the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/2.

Haase, C.S., E.C. Walls, and C.D. Farmer, 1985. "Stratigraphic Data for the Conasauga Group and the Rome Formation on the Copper Creek Fault Block Near Oak Ridge, Tennessee." ORNL/TM-9159.

Lietzke, D.A., S.Y. Lee, and R.E. Lambert, 1988. "Soils, Surficial Geology, and Geomorphology of the Bear Creek Valley Low-Level Waste Disposal Development and Demonstration Program Site." ORNL/TM-10543.

A.1.3 CHESTNUT RIDGE

Ketelle, R.H., and D.D. Huff, 1984. "Site Characterization of the West Chestnut Ridge Site." ORNL/TN-9229.

Martin Marietta Energy Systems, Inc., 1984. "Mineralogical Characterization of West Chestnut Ridge Soils, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." ORNL/TM-9361.

A.2 GEOPHYSICAL INVESTIGATIONS

Bechtel National, Inc., 1984. "Geophysical Survey in Bear Creek Valley Waste Disposal Areas A and B." Y/SUB/84-47974C/5.

Ketelle, R.H., and F.G. Pin, 1983. "Use of Electromagnetic Terrain Conductivity Measurements to Map Liquid Hazardous Waste Migration in Groundwater." ORNL/TM-8865.

Staub, W.P., 1983. "Seismic Refraction Survey of the Central Chestnut Ridge Site." Union Carbide Corporation, Nuclear Division.

A.3 Y-12 PLANT HYDROGEOLOGY

A.3.1 GENERAL

CH2M Hill, 1988. "Ambient Environmental Monitoring Program Assessment. Oak Ridge Reservation, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc.

DeBuchananne, G.D., and R.M. Richardson, 1956. "Groundwater Resources of East Tennessee." Tennessee Division of Geology, Bulletin 58, Part 1.

Haase, C.S., G.A. Gillis, and H.L. King, 1988. "Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy, Oak Ridge Reservation." ORNL/TM-10000.

Law Engineering Testing Company, 1983. "Results of Groundwater Monitoring Studies. Prepared for Union Carbide Corporation, Nuclear Division, Y-12 Plant." Y/SUB/83-47936/1.

McMaster, W.M., 1967. "Hydrologic Data for the Oak Ridge Area, Tennessee." U.S. Geological Survey, Water Supply Paper 1839-N. Prepared in cooperation with the U.S. Atomic Energy Commission.

Pritz, P.M., 1983. "Master Monitoring Plan for Ground Waters and Surface Waters. Oak Ridge Y-12 Plant." W-7404-ENG-26.

A.3.2 BEAR CREEK VALLEY

Bechtel National, Inc., 1984. "Interim Report on Bear Creek Valley Oil Landfarm Geology and Hydrology." Y/SUB/84-47974C/1.

Bechtel National, Inc., 1984. "Geologic and Hydrogeologic Data for Bear Creek Valley Burial Grounds A and B." Y/SUB/84-47974C/2.

Bechtel National, Inc., 1984. "The Geology and Hydrogeology of Bear Creek Valley Waste Disposal Areas A and B." Y/SUB/84/47974C/3.

A.3.2 BEAR CREEK VALLEY (cont.)

Bechtel National, Inc., 1984. "Interim Report on the Geology and Hydrogeology of the Southern and Western Perimeter to the Burial Grounds and the Interior Portions of Bear Creek Valley Waste Disposal Areas Environmental Field Studies." Y/SUB/84-47974C/4.

Bechtel National, Inc., 1984. "Summary Report of Geologic Investigation Conducted During Phase III Well Installation Bear Creek Valley Waste Disposal Area. Prepared for Union Carbide Corporation, Nuclear Division.

Bechtel Civil and Minerals, Inc., 1984. "Report on Burial Grounds A and B, Geology and Hydrogeology, Environmental Field Studies, Bear Creek Waste Disposal Area. Prepared for Union Carbide Corporation, Nuclear Division.

Bechtel National, Inc., 1985. "Geologic Data on Twenty Monitoring Wells Installed in Bear Creek Valley in September and October 1984." Y/SUB/84-47974C/12.

Geraghty & Miller, Inc., 1984. "Summary of Hydrogeologic Data, Spring 1984, Bear Creek Valley Waste Disposal Area." Prepared for Martin Marietta Energy Systems, Inc.

Geraghty & Miller, Inc., 1985. "Findings of the 1984-1985 Preliminary Investigation of Contamination at the S-3 Ponds." Y/SUB/84-00206C/3.

Geraghty & Miller, Inc., 1985. "Proposed Groundwater Monitoring Plans for the New Hope Pond and for Four Disposal Sites on Chestnut Ridge." Y/SUB/85-00206C/4.

Geraghty & Miller, Inc., 1985. "Remedial Alternatives for the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/2.

Geraghty & Miller, Inc., 1985. "The Relation of Groundwater to Mercury Migration at the Y-12 Plant and the Hydrogeologic Effects of Proposed Clean-up Measures." Y/SUB/85-00206C/5.

Geraghty & Miller, Inc., 1987. "Hydrogeologic Investigations of the S-3 Ponds Hazardous Waste Disposal Unit at the Y-12 Plant." Y/SUB/87-00206C/18.

Geraghty & Miller, Inc., 1987. "Preliminary Evaluation of the Hydrogeologic and Water-Quality Data from Phase IV Wells Located in the Bear Creek Valley Waste Disposal Area for the Period Summer 1985 - September 1986." Y/SUB/87-00206C/9.

A.3.2 BEAR CREEK VALLEY (cont.)

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. (Draft).

Haase, C.S., G.A. Gillis, H.L. King, C.W. Kimbrough, and T.M. Mercier, 1987. "Preliminary Assessment of Groundwater Data for the New Hope Pond Site at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-280.

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Preliminary Hydrological and Hydrochemical Assessment of Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant." Y/TS-281.

Haase,C.C., H.L. King, and G.A. Gillis, 1987. "Preliminary Hydrological and Hydrochemical Assessment of the Beta-4 Security Pit, Kerr Hollow Quarry, Ravine Disposal, Rogers Quarry, and United Nuclear Corporation Sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-271.

Martin Marietta Energy Systems, Inc., 1984. "Preliminary Assessment of Existing Contamination in Bear Creek Valley Watershed Area and Potential Remedial Actions for Mitigating Its Impact on Bear Creek." Y/TS-51/1 and Y/TS-51/2.

A.3.3 CHESTNUT RIDGE

Geraghty & Miller, Inc., 1985. "Proposed Groundwater Monitoring Plans for the New Hope Pond and for Four Disposal Sites on Chestnut Ridge." Y/SUB/85-00206C/4.

Geraghty & Miller, Inc., 1986. "Proposed Groundwater Monitoring Plans for the Kerr Hollow and Rogers Quarries." Y/SUB/85-00206C/4 R1.

A.3.3 CHESTNUT RIDGE (cont.)

Haase, C.S., G.A. Gillis, H.L. King, C.W. Kimbrough, and T.M. Mercier, 1987. "Preliminary Analysis of Groundwater Data for the Chestnut Ridge Security Pit Site at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-281.

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Preliminary Hydrological and Hydrochemical Assessment of Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant." Y/TS-281.

Haase,C.C., H.L. King, and G.A. Gillis, 1987. "Preliminary Hydrological and Hydrochemical Assessment of the Beta-4 Security Pit, Kerr Hollow Quarry, Ravine Disposal, Rogers Quarry, and United Nuclear Corporation Sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-271.

Moore, G.K., 1988. "Concepts of Groundwater Occurrence and Flow Near the Oak Ridge National Laboratory, Tennessee." ORNL/TM-10969.

A.3.4 AQUIFER PROPERTIES

Geraghty & Miller, Inc., 1986. "Aquifer Test Data and Design of Recovery Wells, S-3 Ponds. Prepared for Martin Marietta Energy Systems, Inc., Y-12 Plant." Y/SUB/86-00206C/2.

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. (Draft).

Geraghty & Miller, Inc., 1989. "Development of Contaminant Transport Models for Four Constituents at the S-3 Site, Y-12 Plant Oak Ridge, Tennessee." Y/SUB/89-00206C/3.

Geraghty & Miller, Inc., 1989. "Development of Groundwater Flow Models for the S-3 Waste Management Area, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-00206C-1.

Geraghty & Miller, Inc., 1989. "Tracer Study of the Hydrologic System of Upper Bear Creek, Y-12 Facility, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. (Draft).

A.3.4 AQUIFER PROPERTIES (cont.)

Golder & Associates, 1987. "Geohydrologic Packer Testing GW-132, GW-133, GW-134, and GW-135 at the Y-12 Plant Area, Oak Ridge, TN." Y/TS-497.

Golder & Associates, 1987. "Geohydrologic Packer Testing GW-131, and CH-157 at the Y-12 Plant Area, Oak Ridge, Tennessee." Y/TS-496.

King, H.L.and C.S. Haase, 1988. "Summary of Results and Preliminary Interpretations of Hydrogeologic Packer Testing in Core Holes GW-131 through GW-135 and CH-157, Oak Ridge Y-12 Plant." Y/TS-495.

Lozier, W.B., C.A. Spiers, and R. Pearson, 1987. "Aquifer Pump Tests with Tracers." ORNL/SUB/86-32136.

A.3.5 MONITOR-WELL INSTALLATION/DOCUMENTATION

Bechtel National, Inc., 1984. "Interim Report on Bear Creek Valley Oil Landfarm Geology and Hydrology." Y/SUB/84-47974C/1.

Bechtel National, Inc., 1984. "Interim Report on the Geology and Hydrogeology of the Southern and Western Perimeter to the Burial Grounds and the Interior Portions of Bear Creek Valley Waste Disposal Areas Environmental Field Studies." Y/SUB/84-47974C/4.

Bechtel National, Inc., 1984. "Summary Report of Geologic Investigation Conducted During Phase III Well Installation Bear Creek Valley Waste Disposal Area." Prepared for Union Carbide Corporation, Nuclear Division.

Bechtel Civil and Minerals, Inc., 1984. "Report on Burial Grounds A and B, Geology and Hydrogeology, Environmental Field Studies, Bear Creek Waste Disposal Area." Prepared for Union Carbide Corporation, Nuclear Division.

Bechtel National, Inc., 1985. "Geologic Data on Twenty Monitoring Wells Installed in Bear Creek Valley in September and October 1984." Y/SUB/84-47974C/12.

A.3.5 MONITOR WELL INSTALLATION DOCUMENTATION (cont.)

Engineering, Design & Geosciences Group, Inc., 1989. "1988 Monitor-Well Installations at the Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-99005V/2.

Geraghty & Miller, Inc., 1984. "Evaluation of the Monitor Well Network in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/1.

Geraghty & Miller, Inc., 1985. "Guidelines for the Installation of Monitor Wells at the Y-12 Plant." Y/SUB/85-00206/6.

Geraghty & Miller, Inc., 1986. "Phase IV Monitor-Well Drilling Program in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/8.

Geraghty & Miller, Inc., 1987. "Installation of Monitor Wells at the Oil/Solvent Drum Storage Area of the Y-12 Plant Salvage Yard." Y/SUB/87-00206C/16.

Geraghty & Miller, Inc., 1987. "Installation of Monitor Wells at the Salvage Yard and Burial Grounds Area at the Y-12 Plant." Y/SUB/86-00206C/3.

Geraghty & Miller, Inc., 1987. "Monitor Well Installation and Soil Sample Collection at the Oak Ridge Y-12 Plant, S-2 Site." Y/SUB/87-00206C/15.

Geraghty & Miller, Inc., 1987. "Preliminary Evaluation of the Hydrogeologic and Water-Quality Data from Phase IV Wells Located in the Bear Creek Valley Waste Disposal Area for the Period Summer 1985 - September 1986." Y/SUB/87-00206C/9.

Geraghty & Miller, Inc., 1987. "Installation of Monitor-Well at the D-38 Pits and the Low Level Waste Disposal Development Demonstration Site at the Oak Ridge Y-12 Plant." Y/SUB/87-00206C/14.

Geraghty & Miller, Inc., 1989. "Monitor-Well Documentation Report for the 1987 Drilling Program at the Y-12 Plant." Y/SUB/89-00206C/20.

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Fiscal Year 1985 Groundwater Investigation Drilling Program at the Y-12 Plant, Oak Ridge, Tennessee." ORNL/TM-9999.

A.3.5 MONITOR WELL INSTALLATION DOCUMENTATION (cont.)

Haase, C.S., G.A. Gillis, and H.L. King, 1988. "Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy, Oak Ridge Reservation." ORNL/TM-10000.

Mishu, L., 1982 "Subsurface Investigation and Monitoring Wells for Proposed Waste Disposal Area, Y-12 Plant." 81-1020P.

Rothschild, E.R., R.R. Turner, S.H. Stow, M.A. Bogle, L.K. Hyder, O.M. Sealand, and H.J. Wyrick, 1984. "Investigation of Subsurface Mercury at the Oak Ridge Y-12 Plant." ORNL/TM-9092.

A.3.6 WATER-QUALITY MONITORING DATA

Early, T.O. and J. Switek, 1989. "Annual Report of 1988 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Groundwater Surface Elevations." Y/TS-388, P1.

Geraghty & Miller, Inc., 1986. "Findings of the 1985 Drilling and Sampling Program at the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/9.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/1.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/2.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/1.

A.3.6 WATER-QUALITY MONITORING DATA (cont.)

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/2.

Geraghty & Miller, Inc., 1988. " Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/6.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the S-3 Ponds Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/7.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Oil Landfarm Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/8.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/9.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for New Hope Pond at the Y-12 Plant, 1988." Y/SUB/89-00206C/17.

Haase, C.S., G.A. Gillis, H.L. King, C.W. Kimbrough, and T.M. Mercier, 1987. "Preliminary Analysis of Groundwater Data for the Chestnut Ridge Security Pit Site at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-281.

Haase, C.S., G.A. Gillis, H.L. King, C.W. Kimbrough, and T.M. Mercier, 1987. "Preliminary Assessment of Groundwater Data for the New Hope Pond Site at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-280.

A.3.6 WATER-QUALITY MONITORING DATA (cont.)

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Preliminary Hydrological and Hydrochemical Assessment of Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant." Y/TS-281.

Haase, C.S., G.A. Gillis, and H.L. King, 1988. "Annual Report of 1987 Groundwater Monitoring Data for Treatment, Storage, and Disposal Facilities at the Y-12 Plant: Groundwater Surface Elevations." Y/TS-388, P1.

Kimbrough, C.W., and L.W. McMahon, 1988. "RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: Disposal Basin Field Sampling Plan and Field Data." Y/SUB/88-97376/1.

Kimbrough, C.W., and L.W. McMahon, 1988. "RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond Analytical Data Summary." Y/SUB/88-97376/2.

Martin Marietta Energy Systems, Inc., 1987. "Annual Report of 1986 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Groundwater Surface Elevations." Y/TS-242, P1.

Martin Marietta Energy Systems, Inc., 1987. "Annual Report of 1986 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Statistical Evaluation of First Year Data." Y/TS-242/P2.

Martin Marietta Energy Systems, Inc., 1988. "Annual Report of 1987 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Groundwater Surface Elevations." Y/TS-388, P1.

Mercier, T., and C. Kimbrough, 1988. "Annual Report of 1987 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Reporting and Statistical Evaluation of the Subsequent Year (Second) Year Data." Y/TS-388, P2.

A.3.6 WATER-QUALITY MONITORING DATA (cont.)

Mercier, T., and C. Kimbrough, 1989. "Annual Report of 1988 Groundwater Monitoring Data for Treatment, Storage, or Disposal Facilities at the Y-12 Plant: Reporting and Statistical Evaluation of the Subsequent Year (Second) Year Data." Y/TS-511, P2.

U.S. Geological Survey, 1985. "Water-Quality Data for 34 Sites, April-June 1984, Near the Y-12 Plant, the Oak Ridge Reservation, Tennessee." Open-File Report. 85-165.

A.3.7 COMPUTER MODELING

Geraghty & Miller, Inc., 1989. "Development of Groundwater Flow Models for the S-3 Waste Management Area, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-00206C/1.

Geraghty & Miller, Inc., 1989. "Development of Contaminant Transport Models for Four Constituents at the S-3 Site, Y-12 Plant Oak Ridge, Tennessee." Y/SUB/89-00206C/3.

Geraghty & Miller, Inc., 1989. "Development of Contaminant Transport Models for Four Constituents at the S-3 Site, Y-12 Plant Oak Ridge, Tennessee." Y/SUB/89-00206C/3.

Huff, D.D., R.J. Luxmore, and C.L. Begovich, 1976. "TEHM: A Terrestrial Ecosystem Hydrology Model, Oak Ridge National Laboratory." EDFB/IBP-76/8.

Sledge, J.S., and D.D. Huff, 1981. "Computer Model for Determining Fracture Porosity and Permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee." ORNL/TM-7695.

Yeh, G.T., 1981. "AT123D: Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System, Technical Report." ORNL-56020.

A.4 SURFACE-WATER HYDROLOGY

A.4.1 GENERAL

McMaster, W.M., 1967. "Hydrologic Data for the Oak Ridge Area, Tennessee." U.S. Geological Survey, Water Supply Paper 1839-N. Prepared in cooperation with the U.S. Atomic Energy Commission.

Tennessee Valley Authority, 1985. "Oak Ridge Task Force, Instream Contamination Study - Task 1: Waste Sampling and Analysis." TVA Office of Natural Resources and Economic Development.

U.S. Environmental Protection Agency, 1985. "NPDES Permit No. TN0002968 for the Y-012 Plant, August 7, 1985." U.S. Environmental Protection Agency, Washington, D.C.

A.4.2 BEAR CREEK VALLEY

Clapp, R.B., 1985. "Water Budget for Bear Creek." Oak Ridge National Laboratory (Draft II).

Evaldi, R.D., 1984. "Streamflow and Specific Conductance Data for Selected Sites, February 15 Through April 9, 1984, near the Y-12 Plant, The Oak Ridge Reservation, Tennessee." U.S. Geological Survey. Open-File Report 84-625.

Evaldi, R.D., 1985. "Streamflow and Specific Conductance Data for Bear Creek, August 13, 1985. The Oak Ridge Reservation, Tennessee." U.S. Geological Survey. Open-File Report 85-682.

Geraghty & Miller, Inc., 1985. "Presence of Uranium in the Ground Water, Surface Water, Soils, and Sediments in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/7.

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. (Draft).

Hancher, C.W., J.E. Cline, T.E. Austin, G.D. Hackett, B.C.Padgett, R.L. Patton, and M.E. Johnson, 1990. "Treatability Studies - Bear Creek Watershed, Oak Ridge National Laboratory." (Draft).

Martin Marietta Energy Systems, Inc., Environmental Sciences Division, 1983. "Characterization of Y-12 Storm Drain System and Effluents Intersecting into East Fork Poplar Creek." Y/SE-44.

A.4.2 BEAR CREEK VALLEY (cont.)

Martin Marietta Energy Systems, Inc., 1985. "Hydrologic Data on Bear Creek Valley Watershed Area." Y/TS-110.

Martin Marietta Energy Systems, Inc., 1985. "Analytical Results for Water, Sediment, and Soil Samples Collected in the Y-12 Plant Bear Creek Valley Waste Disposal Areas." Y/TS-112.

Martin Marietta Energy Systems, Inc., 1988. "Ecological Evaluation of Bear Creek, 1984 Through 1987." ORNL/TM (Draft).

Martin Marietta Energy Systems, Inc., 1988. "RCRA Facility Investigation Plan for Bear Creek, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Y/TS-417 (Draft).

Turner, R.R., et al., 1985. "Sources and Discharges of Mercury in Drainage Waters at the Oak Ridge Y-12 Plant Oak Ridge, Tennessee." Y/TS-90.

Union Carbide Corporation, Nuclear Division, 1984. "Program for Elimination of Process Waste Discharge into East Fork Poplar Creek." Y/SE-52.

Y-12 Environmental Affairs Department, 1984. "Monitoring Data from Upper Bear Creek Report." Y/TS-45.

A.4.3 WATER-QUALITY MONITORING DATA

Camp, Dresser, and McKee, Inc., 1987. "Draft Comprehensive Sampling Program for East Fork Poplar Creek, Source Pollution Assessment and Control Plan, Y-12 Plant, Oak Ridge, Tennessee." Camp, Dresser, and McKee, Inc., Atlanta, Georgia.

Evaldi, R.D., 1984. "Streamflow and Specific Conductance Data for Selected Sites, February 15 Through April 9, 1984, Near the Y-12 Plant, The Oak Ridge Reservation, Tennessee." U.S. Geological Survey. Open-File Report, 84-625.

Evaldi, R.D., 1985. "Streamflow and Specific Conductance Data for Bear Creek, August 13, 1985. The Oak Ridge Reservation, Tennessee." U.S. Geological Survey. Open-File Report, 85-682.

A.4.3 WATER-QUALITY MONITORING DATA (cont.)

Geraghty & Miller, Inc., 1985. "Presence of Uranium in the Ground Water, Surface Water, Soils, and Sediments in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/7.

Martin Marietta Energy Systems, Inc., 1983. "Characterization of Y-12 Storm Drain System and Effluents Intersecting into East Fork Poplar Creek." Y/SE-44.

Martin Marietta Energy Systems, Inc., 1985. "Analytical Data on Ground Water, Surface Water and Sediment Samples Taken in the Y-12 Plant Bear Creek Valley Waste Disposal Areas." Y/TS-88.

Martin Marietta Energy Systems, Inc., 1988. "RCRA Facility Investigation Plan for Bear Creek, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Y/TS-417 (Draft).

Turner, R.R., et al., 1985. "Sources and Discharges of Mercury in Drainage Waters at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-90.

Van Winkle, W., et al., 1984. "Mercury Contamination in East Fork Poplar Creek and Bear Creek, Oak Ridge National Laboratory." ORNL/TM-8894.

A.5 SOILS AND SEDIMENTS

A.5.1 GENERAL

Hoos, A.B., and Z.C. Bailey, 1986. "Reconnaissance of Surficial Geology, Regolith Thickness, and Configuration of the Bedrock Surface in Bear Creek and Union Valleys, Near Oak Ridge, Tennessee." U.S. Geological Survey. Water-Resources Investigations Report, 86-4165.

Moneymaker, R.H., 1981. "Soil Survey of Anderson County, Tennessee." National Cooperative Soil Survey.

Tennessee Valley Authority, 1985. "Oak Ridge Task Force, Instream Contamination Study - Task 2: Sediment Characterization, Vol 1 and 2." TVA Office of Natural Resources and Economic Development..

Tennessee Valley Authority, 1985. "Oak Ridge Task Force, Instream Contamination Study - Task 3: Sediment Transport." TVA Office of Natural Resources and Economic Development.

U.S. Geological Survey, 1985. "Water-Quality Data for 34 Sites, April-June 1984, Near the Y-12 Plant, the Oak Ridge Reservation, Tennessee." Open-File Report. 85-165.

Y-12 Environmental Affairs Department, 1984. "Monitoring Data from Upper Bear Creek." Y/TS-45.

A.5.2 BEAR CREEK VALLEY"

Advanced Sciences, Inc., 1987. "Sediment Control Alternatives for East Fork Poplar Creek, Oak Ridge, Tennessee, Phase I, II, III, and IV." Prepared for the Department of Energy, Oak Ridge Operations.

Daniel, D.E., 1989. "Evaluation of Low Permeability Layer for S-3 Pond Closure at the Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-TN526V/2.

Daniel, D.E., 1989. "Permeability of Compacted Soils from the East and West Borrow Areas, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-TN526V.

Geotechnical Engineering, 1987. "Geotechnical Investigation, Proposed New Containment Pond for Closure of New Hope Pond, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/87-47927/1.

A.5.2 BEAR CREEK VALLEY (cont.)

Geraghty & Miller, Inc., 1985. "Presence of Uranium in the Ground Water, Surface Water, Soils, and Sediments in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/7.

Geraghty & Miller, Inc., 1986. "Phase I and II Soil Sampling at the Y-12 Plant Salvage Yard Oil/Solvent Drum Storage Area for RCRA Closure." Y/SUB/86-00206C/1.

Geraghty & Miller, Inc., 1987. "Soil Sampling at the Acetonitrile Drum Yard (S-015), Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/87-00206C/7.

Geraghty & Miller, Inc., 1987. "Soil Sampling at the Southern Portion of the Interim Drum Storage Yard (S-030) at the Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/87-00206C/8.

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. (Draft).

Lietzke, D.A., S.Y. Lee, and R.E. Lambert, 1988. "Soils, Surficial Geology, and Geomorphology of the Bear Creek Valley Low-Level Waste Disposal Development and Demonstration Program Site." ORNL/TM-10543.

Martin Marietta Energy Systems, Inc., 1984. "Characterization and Remedial Alternatives for Sediments in Upper Bear Creek." Y/TS-56.

Martin Marietta Energy Systems, Inc., 1985. "Analytical Data on Ground Water, Surface Water and Sediment Samples Taken in the Y-12 Plant Bear Creek Valley Waste Disposal Areas." Y/TS-88.

Martin Marietta Energy Systems, Inc., 1985. "Analytical Results for Water, Sediment, and Soil Samples Collected in the Y-12 Plant Bear Creek Valley Waste Disposal Areas." Y/TS-112.

Martin Marietta Energy Systems, Inc., 1988. "RCRA Facility Investigation Plan for Bear Creek, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Y/TS-417 (Draft).

A.5.2 BEAR CREEK VALLEY (cont.)

Rothschild, E.R., R.R. Turner, S.H. Stow, M.A. Bogle, L.K. Hyder, O.M. Sealand, and H.J. Wyrick, 1984. "Investigation of Subsurface Mercury at the Oak Ridge Y-12 Plant. Oak Ridge National Laboratory." ORNL/TM-9092.

Sanders, M., 1972. "New Hope Pond Dredging Operation, Union Carbide Corporation, Nuclear Division, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/DD-128.

Turner, R.R., and G.E. Kamp, 1984. "Characterization and Remedial Alternatives for Sediments in Upper Bear Creek. Oak Ridge Y-12 Plant, Oak Ridge, TN." Y/TS-56.

Turner, R., 1988. "Sampling and Analysis of Soil from 1985 Tank Farm Excavations Near S-3 Ponds Y-12 Plant, Oak Ridge, Tennessee." Y/TS-473.

Union Carbide Corporation, Nuclear Division, 1984. "Sediment Assessment and Inventory of Existing Contamination and Biological Data of Two Oil Retention Ponds in the Y-12 Plant Bear Creek Valley Waste Disposal Area." Y/IA-165.

A.5.3 CHESTNUT RIDGE

Martin Marietta Energy Systems, Inc., 1984. "Mineralogical Characterization of West Chestnut Ridge Soils, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." ORNL/TM-9361.

A.5.4 GEOTECHNICAL DATA

Geotechnical Engineering, 1987. " Geotechnical Investigation, Proposed New Containment Pond for Closure of New Hope Pond, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/87-4797/1.

Law Engineering Testing Company, 1983. "Stability Analyses of Waste Disposal Facilities at the Y-12 Plant." Y/SUB/83-48-9712/1.

A.5.4 GEOTECHNICAL DATA (cont.)

Mishu, L., 1982. "Subsurface Investigation and Monitoring Wells for Proposed Waste Disposal Area, Y-12 Plant." Prepared for Union Carbide Corporation, Nuclear Division.

Mishu, L., 1982. "Subsurface Analysis of Waste Disposal Facilities at the Y-12 Plant." Y/SUB/82-24700/2.

Mishu, R., 1986. "Geotechnical Evaluation for the Proposed DARA Borrow Pit Bear Creek Area." Prepared for Martin Marietta Energy Systems, Inc.

A.5.5 GEOCHEMICAL DATA

Geraghty & Miller, Inc., 1985. "Presence of Uranium in the Ground Water, Surface Water, Soils, and Sediments in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/7.

Geraghty & Miller, Inc., 1988. "Conceptual Design of a Shallow Seepage Collection System for the Oil-Stained Area West of Y-12 Burial Ground A North." Y/SUB/88-00206C/4.

Herbes, S.E., 1990. "Contaminants in Soil at the Oak Ridge Y-12 Plant Oil Landfarm: Results of 1985-1986 Sampling and Analysis Program." (Draft).

Herbes, S.E., 1988. "PCB Contamination in the Sediments of the Oil Retention Ponds and Associated Tributary Channels at the Burial Grounds of the Oak Ridge Y-12 Plant." Y/TS-431.

Hoffman, F.O., B.G. Blaylock, C.C. Travis, K.L. Daniels, E.L. Etnier, K.E. Cowser, and C.W. Weber, 1984. "Preliminary Screening of Contaminants in Sediments." ORNL/TM-9370.

Martin Marietta Energy Systems, Inc., 1984. "Characterization and Remedial Alternatives for Sediments in Upper Bear Creek." Y/TS-56.

McMahon, L.W., 1988. "Sampling and Analysis to Support Excavation of Blue Lagoon Sediment Build-up." Y/TS-481.

A.5.5 GEOCHEMICAL DATA (cont.)

Turner, R., 1988. "Sampling and Analysis of Soil from 1985 Tank Farm Excavations Near S-3 Ponds Y-12 Plant, Oak Ridge, Tennessee." Y/TS-473.

Union Carbide Corporation, Nuclear Division, 1984. "Sediment Assessment and Inventory of Existing Contamination and Biological Data of Two Oil Retention Ponds in the Y-12 Plant Bear Creek Valley Waste Disposal Area." Y/IA-165.

A.6 WASTE CHARACTERIZATION AND WASTE INVENTORIES

A.6.1 GENERAL

Bailey, J.K., 1983. "Y-12 Plant Temporary Storage Facility for Low-Level Radioactive Solid Waste. Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/IA-162.

Ketelle, R.H., and D.D. Huff, 1984. "Site Characterization of the West Chestnut Ridge Site." ORNL/TN-9229.

Struxness, E.G., and R.J. Morton, 1960. "Health Physics Annual Progress Report for Period Ending July 31, 1960, Radioactive Waste Disposal, Oak Ridge National Laboratory." ORNL-2994.

A.6.2 BEAR CREEK VALLEY

Bechtel National, Inc., 1983. "Characterization of Waste Water from Burial Ground Oil Ponds, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Prepared for Union Carbide Corporation, Nuclear Division.

Francke, H.C., 1973. "Nitrate Effluents and Their Effect on the Environment as Related to the Y-12 Plant. Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/DA-5085.

Geraghty & Miller, Inc., 1989. Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." (Draft)

H&R Technical Associates, Inc./Geraghty & Miller, Inc., 1984. "An Assessment of the Hazards from Mixing Incompatible Wastes in the Bear Creek Waste Disposal Area." Y/SUB/84-00206C/2.

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Preliminary Hydrological and Hydrochemical Assessment of Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant." Y/TS-281.

Jeter, I.W. and J.M. Napier, 1978. "Chemical Analysis of the S-3 Disposal Ponds April 1978." Y/DA-7794.

Kimbrough, C.W., and R.R. Turner, 1987. "Field Notebook: Sampling and Analysis of Sludges in the S-3 Ponds at the Y-12 Plant." Y/TS-294.

A.6.2 BEAR CREEK VALLEY (cont.)

Lee, S.Y., and L.K. Hyder, 1985. "Evaluation of the Remobilization of Technetium and Uranium Associated with Sludge in the S-3 Ponds at the Y-12 Plant." Internal Correspondence, Martin Marietta Energy Systems, Inc.

Loar, J.L., J.M.Giddings, J.A. Solomon, and A.J. Gatz, 1984. "Ecological Studies Associated with Implementation of Improved Waste Management Operation in Bear Creek Valley." A Progress Report to Department of Waste Management Y-12 Plant.

Napier, J.M., et al., 1985. "In Situ Treatment of the S-3 Ponds." Y/TS-112.

Sanders, M., 1972. "New Hope Pond Dredging Operation, Union Carbide Corporation, Nuclear Division, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/DD-128.

Saunders, M.B., and J.M. Napier, 1986. "1981 Analysis of the S-3 Ponds (1981 report revised in 1986)." Y/DZ-12, Rev. 1.

Union Carbide Corporation, Nuclear Division, 1983. "The Chemical and Radiological Characterization of the S-3 Ponds." Y/MA-6400.

A.6.3 CHESTNUT RIDGE

Butz, T.R., and H.H. Stoner, 1983. "Disposal of United Nuclear Company Materials at the Y-12 Plant." Health, Safety, and Environmental Affairs Division, Union Carbide Corporation, Y-12 Plant, Oak Ridge, TN.

Haase, C.S., G.A. Gillis, and H.L. King, 1987. "Preliminary Hydrological and Hydrochemical Assessment of Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant." Y/TS-281.

Martin Marietta Energy Systems, Inc., 1984. "Inventory of Disposals Conducted in the Chestnut Ridge Security Pit, Y-12 Plant, Oak Ridge, Tennessee." Y/DS-191.

Martin Marietta Energy Systems, Inc., 1984. "Inventory of Disposals Conducted in Kerr Hollow Quarry, Pre-1951 Through March 1984." Y/DS-187.

A.6.3 CHESTNUT RIDGE (cont.)

Martin Marietta Energy Systems, Inc., 1984. "Inventory of Disposals Conducted in Rogers Quarry, May 1965 Through March 1984." Y/DS-185.

Sanders, M., 1983. "Leachability of Samples from New Hope Pond Disposal Basin." Y/DZ-81.

Sanders, M.B., 1983. "Leachability of Samples from New Hope Pond Disposal Basin, USDOE Y-12 Plant, Oak Ridge, Tennessee." Y/DS-81, Rev. 1.

Union Carbide Corporation, Nuclear Division, 1983. "Characterization of Sediments from New Hope Pond and the New Hope Pond Sediment Basin, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/IA-164.

Union Carbide Corporation, Nuclear Division, 1983. "The Chemical and Radiological Characterization of Sediments from New Hope Pond and the New Hope Sediment Basin." Y/IA-164.

A.7 CONTAMINATION ASSESSMENTS

A.7.1 GENERAL

Law Engineering Testing Company, 1983. "Results of Groundwater Monitoring Studies. Prepared for Union Carbide Corporation, Nuclear Division, Y-12 Plant." Y/SUB/83-47936/1.

Martin Marietta Energy Systems, Inc., 1986. "Environmental Surveillance of the Oak Ridge Reservation and Surrounding Environs During 1985." ORNL-6271.

Martin Marietta Energy Systems, Inc., 1986. "Environmental Surveillance of the Oak Ridge Reservation and Surrounding Environs During 1985." ORNL-6271.

Martin Marietta Energy Systems, Inc., 1987. "Environmental Surveillance of the U.S. Department of Energy, Oak Ridge Reservation and Surrounding Environs During 1986. Volume I: Summary and Conclusions." ES/ESH/V1.

Martin Marietta Energy Systems, Inc., 1987. "Environmental Surveillance of the U.S. Department of Energy, Oak Ridge Reservation and Surrounding Environs During 1986. Volume II: Data Presentation." ES/ESH/V2.

Martin Marietta Energy Systems, Inc., 1988. "Environmental Surveillance of the U.S. Department of Energy, Oak Ridge Reservation and Surrounding Environs During 1987. Volume I: Summary and Conclusions." ES/ESH-4/V1.

Martin Marietta Energy Systems, Inc., 1988. "Environmental Surveillance of the U.S. Department of Energy, Oak Ridge Reservation and Surrounding Environs During 1987. Volume II: Data Presentation." ES/ESH-4/V2.

Martin Marietta Energy Systems, Inc., 1988. "Environmental Surveillance Procedures Quality Control Program, Martin Marietta Energy Systems, Inc., Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." ESH/SUB/87-21706/1.

A.7.2 BEAR CREEK VALLEY

Francke, H.C., 1973. "Nitrate Effluents and Their Effect on the Environment as Related to the Y-12 Plant. Oak Ridge Y-12 Plant, Oak Ridge, TN." Y/DA-5085.

Geraghty & Miller, Inc., 1985. "Findings of the 1984-1985 Preliminary Investigation of Contamination at the S-3 Ponds." Y/SUB/84-00206C/3).

Geraghty & Miller, Inc., 1985. "Remedial Alternatives for the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/2.

Geraghty & Miller, Inc., 1985. "Presence of Uranium in the Ground Water, Surface Water, Soils, and Sediments in the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/7.

Geraghty & Miller, Inc., 1986. "Findings of the 1985 Drilling and Sampling Program at the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/9.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/1.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/2.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1988. "Conceptual Design of a Shallow Seepage Collection System for the Oil-Stained Area West of Y-12 Burial Ground A North." Y/SUB/88-00206C/4.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/1.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/2.

A.7.2 BEAR CREEK VALLEY (cont.)

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for New Hope Pond at the Y-12 Plant, 1988." Y/SUB/89-00206C/17.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit at the Y-12 Plant , 1988." Y/SUB/89-00206C/6.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the S-3 Site Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/7.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Oil Landfarm Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/8.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/9.

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." (Draft).

Haase,C.C., H.L. King, and G.A. Gillis, 1987. "Preliminary Hydrological and Hydrochemical Assessment of the Beta-4 Security Pit, Kerr Hollow Quarry, Ravine Disposal, Rogers Quarry, and United Nuclear Corporation Sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-271.

Haase, C. S. and H. L. King, 1990. "Report and preliminary assessment of the occurrence of dense, nonaqueous phase liquids in the Bear Creek Burial Grounds Hazardous Waste Disposal Unit at the Oak Ridge Y-12 Plant." Y/TS-629.

Lee, S.Y., and L.K. Hyder, 1985. "Evaluation of the Remobilization of Technetium and Uranium Associated with Sludge in the S-3 Ponds at the Y-12 Plant." Internal Correspondence, Martin Marietta Energy Systems, Inc.

A.7.2 BEAR CREEK VALLEY (cont.)

Martin Marietta Energy Systems, Inc., 1984. "Preliminary Assessment of Existing Contamination in Bear Creek Valley Watershed Area and Potential Remedial Actions for Mitigating Its Impact on Bear Creek." Y/TS-51/1 and Y/TS-51/2.

Martin Marietta Energy Systems, Inc., 1985. "Appendices: Remedial Alternatives for Bear Creek Valley Waste Disposal Area, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-109.

Rothschild, E.R., R.R. Turner, S.H. Stow, M.A. Bogle, L.K. Hyder, O.M. Sealand, and H.J. Wyrick, 1984. "Investigation of Subsurface Mercury at the Oak Ridge Y-12 Plant. Oak Ridge National Laboratory." ORNL/TM-9092.

Struxness, E.G., and R.J. Morton, 1960. "Health Physics Annual Progress Report for Period Ending July 31, 1960, Radioactive Waste Disposal, Oak Ridge National Laboratory." ORNL-2994.

Turner, R.R., et al., 1985. "Sources and Discharges of Mercury in Drainage Waters at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-90.

Union Carbide Corporation, Nuclear Division, 1983. "Mercury at the Y-12 Plant - A Summary of the 1983 UCC-ND Task Force Study, Oak Ridge Y-12 Plan." Y/EX-23.

Union Carbide Corporation, Nuclear Division, 1984. "Inventory of Existing Contamination in the Y-12 Plant Bear Creek Valley Oil Landfarm Area." Y/IA-166.

A.7.3 CHESTNUT RIDGE

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/6.

Haase,C.C., H.L. King, and G.A. Gillis, 1987. "Preliminary Hydrological and Hydrochemical Assessment of the Beta-4 Security Pit, Kerr Hollow Quarry, Ravine Disposal, Rogers Quarry, and United Nuclear Corporation Sites at the Y-12 Plant, Oak Ridge, Tennessee." Y/TS-271.

A.8 REGULATORY DOCUMENTS

A.8.1 RCRA CLOSURE PLANS

Battelle Columbus Division, 1986. "Geologic Report and RCRA Closure Plan for S-3 Ponds, U.S. DOE Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc.

Battelle Columbus Division, 1986. "RCRA Closure Plan for the Chestnut Ridge Security Pits. Prepared for Martin Mañetta Energy Systems, Inc." Y/TS-286.

Battelle Columbus Division, 1987. "Draft RCRA Closure/Post-Closure Plan for Bear Creek Burial Grounds U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc.

Bohrman, D.E., M. Willoughby, and M.W. Sherrill, 1988. "Hazardous Waste Storage Area, Southern Portion of Interim Drum Yard (S-030), Summary of Partial Closure Under Rules Governing Hazardous Waste Management in Tennessee." Y/TS-347/7.

Martin Marietta Energy Systems, Inc., 1988. "Revised RCRA Closure Plan for the Burial Grounds." Y/TS-395.

Martin Marietta Energy Systems, Inc., 1988. "Revised RCRA Closure Plan for the Oil Landfarm." Y/TS-392.

Martin Marietta Energy Systems, Inc., 1988. "Revised RCRA Closure Plan for the Oil Retention Ponds, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-392.

Martin Marietta Energy Systems, Inc., 1988. "Revised Closure Plan for New Hope Pond." Y/TS-389.

Martin Marietta Energy Systems, Inc., 1988. "Revised RCRA Closure Plan for the Chestnut Ridge Security Pits, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-391.

Martin Marietta Energy Systems, Inc., 1988. "Revised RCRA Closure Plan for the S-3 Ponds." Y/TS-393.

A.8.1 RCRA CLOSURE PLANS (cont.)

Willoughby, M., S.H. Welch, and S.E. Herbes, 1987. "RCRA Closure Plan (Revised) Interim Drum Yard (S-030) - Y-12 Plant." Y/TS-3467.

A.8.2 RCRA POST-CLOSURE PERMIT APPLICATIONS (PCPAs)

Geraghty & Miller, Inc., 1988 (Revised). "Post Closure Permit Application for the S-3 Ponds Waste Management Area at the Y-12 Plant." Y/SUB/87-00206C/11.

Geraghty & Miller, Inc., 1988 (Revised). Post Closure Permit Application for the Oil Landfarm Waste-Management Area at the Y-12 Plant. Prepared for Martin Marietta Energy Systems, Inc. Y/SUB/87-00206C/12.

Geraghty & Miller, Inc. 1988 (Revised). "Post Closure Permit Application for the Burial Grounds Waste-Management Area at the Y-12 Plant." Y/SUB/87-00206C/13.

Geraghty & Miller, Inc., 1989. "Post Closure Permit Application for Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit at the Y-12 Plant." Y/SUB/89-00206C/10.

Lee Wan & Associates, Inc., 1989 (Revised). "Post Closure Permit Application for the New Hope Pond Site at the Y-12 Plant." (Draft).

Lee Wan & Associates, Inc., 1989 (Revised). "Post Closure Permit Application for the Chestnut Ridge Sediment Disposal Basin at the Y-12 Plant." Y/TS-520.

A.8.3 RCRA GROUNDWATER QUALITY ASSESSMENT PLANS (GWQAPs)

Geraghty & Miller, Inc., 1987. "Proposed RCRA Groundwater Quality Assessment Plan for New Hope Pond at the Y-12 Plant." Y/SUB/87-00206C/17.

Geraghty & Miller, Inc., 1987. "Proposed RCRA Groundwater Quality Assessment Plan for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant." Y/SUB/87-00206C/6.

A.8.3 RCRA GROUNDWATER QUALITY ASSESSMENT PLANS (GWQAPs) (cont.)

Geraghty & Miller, Inc., 1987. "Proposed RCRA Groundwater Quality Assessment Plan for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant." Y/SUB/87-00206C/6.

Geraghty & Miller, Inc., 1987. "Proposed RCRA Groundwater Quality Assessment Plan for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant." Y/SUB/88-00206C/3.

Geraghty & Miller, Inc., 1988. "Proposed Groundwater Quality Assessment Plan for Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit at the Y-12 Plant. Prepared for Martin Marietta Energy Systems, Inc." Y/SUB/87-00206C/19.

A.8.4 RCRA GROUNDWATER QUALITY ASSESSMENT REPORTS (GWQARs)

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/1.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/2.

Geraghty & Miller, Inc., 1987. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1986." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the S-3 Ponds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/2.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the Oil Landfarm Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/3.

Geraghty & Miller, Inc., 1988. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1987." Y/SUB/87-00206C/4.

A.8.4 RCRA GROUNDWATER QUALITY ASSESSMENT REPORTS (GWQARs) (cont.)

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for New Hope Pond at the Y-12 Plant, 1988." Y/SUB/89-00206C/17.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the S-3 Ponds Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/7.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Oil Landfarm Waste-Management Area at the Y-12 Plant, 1988." Y/SUB/89-00206C/8.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Burial Grounds Hazardous-Waste Disposal Unit at the Y-12 Plant, 1988." Y/SUB/89-00206C/9.

Geraghty & Miller, Inc., 1989. "Groundwater Quality Assessment for the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit at the Y-12 Plant , 1988." Y/SUB/89-00206C/6.

A.8.5 RCRA ALTERNATE CONCENTRATION LIMIT (ACL) DEMONSTRATIONS

Geraghty & Miller, Inc., 1989. "Alternate Concentration Limit Demonstration for the S-3 Waste Management Area Y-12 Plant, Oak Ridge, Tennessee." (Draft).

A.8.6 RCRA FACILITY ASSESSMENTS (RFAs)

Murphy, J.L., 1989. "Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment." Y/TS-273, Supp.4.

Welch, S.H., 1987. "Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment Container Accumulation Areas." Y/TS-273, Supp.2.

A.8.6 RCRA FACILITY ASSESSMENTS (RFAs) (cont.)

Welch, S.H., C.S. Haase, C.W. Kimbrough, and T.M. Mercier, 1987. "Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment, Volumes I, II, and III." Y/TS-273.

Wiggins, K.D., S.H. Welch, 1988. "Supplement to Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment." Y/TS-273, Supp.1.

Wiggins, K.D., S.H. Welch, 1988. "Supplement to Solid Waste Management Unit Information for Y-12 Plant RCRA 3004(u) Facility Assessment Container Accumulation Areas." Y/TS-273, Supp.3.

A.8.7 RCRA FACILITY INVESTIGATIONS (RFIs)

Haase, C.S., 1987. "RCRA Facility Investigation Plan for the S-2 Site (D-103) at the Oak Ridge Y-12 Plant." Y/TS-349.

Martin Marietta Energy Systems, Inc., 1988. "RCRA Facility Investigation Plan for Bear Creek, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Y/TS-417 (Draft).

Peer Consultants, P.C., MCI Consulting Engineers, Inc., and NUS Corporation, 1987. "RCRA Facility Investigation Plan for East Fork Poplar Creek and the Oak Ridge Sewer Line Beltway, U.S. DOE Y-12 Plant, Oak Ridge Tennessee." Y/TS-366.

Welch, S.H., 1987. "RCRA Facility Investigation Plan Building 9418-3 Uranium Vault (D-115) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-356.

A.8.7 RCRA FACILITY INVESTIGATIONS (RFIs) (cont.)

Welch, S.H., 1987. "RCRA Facility Investigation Plan Rust Spoil Area (D-106) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-354.

Welch, S.H., 1987. "RCRA Facility Investigation Plan Spoil Area I (D-107) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-363.

Welch, S.H., 1987. "RCRA Facility Investigation Plan Tank 2064-U (S-205) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-357.

Welch, S.H., 1987. "RCRA Facility Investigation Plan Waste Coolant Processing Facility (T-038) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-358.

Welch, S.H., 1987. "RCRA Facility Investigation Plan Waste Z-Oil Tank (S-121) Y-12 Plant, Oak Ridge, Tennessee." Y/TS-355.

Wiggins, K.D., 1988. "RCRA Facility Investigation Plan, General Document, Volume II: Quality Assurance Project Plan, U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Y/TS-352.

Wiggins, K.D., et al., 1988. "RCRA Facility Investigation Plan, General Document, Volume III: Data Management Plan." Y-TS-352.

A.8.8 CERCLA REPORTS

H&R Technical Associates, Inc., 1988. "CERCLA Phase II Report Characterization of Inactive Hazardous Waste Disposal Sites. U.S. DOE Y-12 Plant, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc. H&R 260-10 (Draft).

A.8.8 CERCLA REPORTS (cont.)

Martin Marietta Energy Systems, Inc., 1986. "Draft Report Phase I Installation Assessment of Inactive Hazardous Waste Disposal Sites at the Y-12 Plant." Y/TS-114.

A.8.9 UNDERGROUND STORAGE TANK REPORTS

Geraghty & Miller, Inc., 1988. "Findings of Gasoline Seepage Study at the Rust Garage Area of the Y-12 Plant, Oak Ridge, Tennessee." (Letter Report).

Geraghty & Miller, Inc., 1989. "Interim Response Work Plan for Sump Removal and Release Determination at the Salvage Yard Drum Deheader Facility, Department of Energy Y-12 Plant, Oak Ridge, Tennessee." (Draft).

Wiggins, K.D., et al., 1989. "Environmental Assessment Plan for the Underground Storage Tank Site at Building 9201-1, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-494.

A.9 SAMPLING AND ANALYSIS PROTOCOLS

Advanced Sciences, Inc., 1988. "Environmental Surveillance Procedures Quality Control Program, Martin Marietta Energy Systems, Inc." Edited by C.W. Kimbrough, L.W. Long, and L.W. McMahon. ESH/Sub/87-21706/1.

Kimbrough, C.W., 1987. "Environmental Monitoring Procedures Manual." Y/TS-295.

Martin Marietta Energy Systems, Inc., 1985. "Analytical Quality Assurance/Quality Control Data for 1983 Through 1984 Characterization of Water, Soil, and Sediment for Bear Creek Valley Waste Disposal Areas, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-111.

Martin Marietta Energy Systems, Inc., 1985. "Field Sampling and Laboratory Analytical Methods Used for 1983 Through 1984 Characterization of Water, Soil, and Sediment for Bear Creek Valley Waste Disposal Areas, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-113.

Martin Marietta Energy Systems, Inc., 1986. "Martin Marietta Energy Systems Environmental and Effluent Analysis Manual, Oak Ridge Y-12 Plant."

A.10 RISK AND EXPOSURE ASSESSMENTS

Geraghty & Miller, Inc., 1989. "Human Health and Environmental Risk Assessment of the S-3 Waste Management Area, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-00206C/12.

A.11 REMEDIAL ACTION STUDIES

CH2M Hill, 1988. "Ambient Environmental Monitoring Program Assessment. Oak Ridge Reservation, Oak Ridge, Tennessee." Prepared for Martin Marietta Energy Systems, Inc.

Daniel, D.E., 1989. "Evaluation of Low Permeability Layer for S-3 Pond Closure at the Y-12 Plant, Oak Ridge, Tennessee. Y/SUB/89-TN526V/2.

Daniel, D.E., 1989. "Permeability of Compacted Soils from the East and West Borrow Areas, Y-12 Plant, Oak Ridge, Tennessee." Y/SUB/89-TN526V.

Geraghty & Miller, Inc., 1988. "Conceptual Design of a Shallow Seepage Collection System for the Oil-Stained Area West of Y-12 Burial Ground A North." Y/SUB/88-00206C/4.

Hancher, C.W., J.E. Cline, T.E. Austin, G.D. Hackett, B.C.Padgett, R.L. Patton, and M.E. Johnson, 1990. "Treatability Studies - Bear Creek Watershed, Oak Ridge National Laboratory." (Draft).

Martin Marietta Energy Systems, Inc., 1984. "Characterization and Remedial Alternatives for Sediments in Upper Bear Creek." Y/TS-56.

Geraghty & Miller, Inc., 1985. "Remedial Alternatives for the Bear Creek Valley Waste Disposal Area." Y/SUB/85-00206C/2.

Loar, J.L., J.M. Giddings, J.A. Solomon, A.J. Gatz, 1984. "Ecological Studies Associated with Implementation of Improved Waste Management Operation in Bear Creek Valley." A Progress Report to Department of Waste Management Y-12 Plant.

Martin Marietta Energy Systems, Inc., 1984. "Preliminary Assessment of Existing Contamination in Bear Creek Valley Watershed Area and Potential Remedial Actions for Mitigating Its Impact on Bear Creek." Y/TS-51/1 and Y/TS-51/2.

Martin Marietta Energy Systems, Inc., 1985. "Appendices: Remedial Alternatives for Bear Creek Valley Waste Disposal Area, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-109.

Martin Marietta Energy Systems, Inc., 1987. "Design Criteria for Environmental Improvements Project Number 84-D-124 Disposal Area Remedial Action WBS1.2.2., Y-12 Plant, Oak Ridge, Tennessee." Y/EN-979-54.

Martin Marietta Energy Systems, Inc., 1987. "Information Presented at November 18, 1987 Meeting on Y-12 Plant Remedial Action Program." Y/TS-353.

Martin Marietta Energy Systems, Inc., 1987. "Volume I and II Program Overview Environmental Restoration Program Closures and Post Closure Activities Remedial Action Program Description." Y/EN-2246.

Martin Marietta Energy Systems, Inc., 1988. "Volume III Cost Estimate of the Environmental Restoration Program Closures and Post Closure Activities Remedial Action Program Description." Y/EN-2246 .

Turner, R.R., and G.E. Kamp, 1984. "Characterization and Remedial Alternatives for Sediments in Upper Bear Creek. Oak Ridge Y-12 Plant, Oak Ridge, Tennessee." Y/TS-56.

DISTRIBUTION

DEPARTMENT OF ENERGY

G. W. Bodenstein
C. S. Gist
S. L. Glover
H. W. Hibbitts
E. C. Phillips (5)
T. S. Tison

HEALTH, SAFETY, ENVIRONMENT AND ACCOUNTABILITY

M. S. Burris
S. D. Easterling
J. M. Eaton
H. L. Fellers, Jr.
K. G. Hanzelka
H. E. Harper
C. C. Hill
J. B. Hunt
R. M. Keyser
C. W. Kimbrough
H. L. King
L. W. McMahon
L. L. Oakes
J. E. Stone
L. O. Vaughan
S. W. Wiley

ENVIRONMENTAL AND SAFETY ACTIVITIES

L. W. Long
M. E. Mitchell
T. P. A. Perry
J. G. Rogers
C. L. Stair

ENGINEERING

R. O. Barnett
W. D. Barton
N. W. Durfee

H&R TECHNICAL ASSOCIATES, INC.

T. M. Mercier

ENVIRONMENTAL SCIENCES

C. S. Haase (2)
T. O. Early
J. M. Forstrom
D. D. Huff
W. M. McMaster

HEALTH AND SAFETY

R. K. White

ENERGY

R. H. Ketelle

WASTE MANAGEMENT

I. W. Jeter
M. J. E. Shelton

ENVIRONMENTAL RESTORATION

L. D. Bates/D. W. Swindle
S. H. Welch

GERAGHTY & MILLER, INC.

J. A. Archer (2)

QUALITY AND TECHNICAL SERVICES

L. P. Burnett

ENVIRONMENTAL COORDINATORS

R. E. Blake - Ports
G. E. Butterworth - ORGDP
F. C. Kornegay - ORNL
S. L. Shell - PGDP (Paducah)

J. E. Keyes
Y-12 Central Files - RC